PCWorld

Intel Skylake

All the speeds, feeds, and prices

TABLE OF CONTENTS

» DEPARTMENTS

» FEATURES

» COLUMNS

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NEWS

CONTENTS

Intel Skylake: All the speeds, feeds, and prices, and which one is right for you

Take a deep dive into Skylake's 48 new CPUs, from energy-sipping mobile versions to beefy overclockers.

BY MARK HACHMAN

Trying to figure out which sixth-generation Intel Core chip to buy in Intel's Skylake family is like going to a preseason baseball or football game: There are numbers everywhere. Somewhere in the crowd are the superstars. But which ones?

We can't test everything at *PCWorld,* but what we can do is provide a handy scorecard of the Skylake chips Intel launched at the IFA show in Berlin in early September. We've already told you why Skylake is a "sixth-generation CPU," (go.pcworld.com/6thgencpu) what you need to know about Skylake, and even an early review of the i7-6700K (go.pcworld.com/i7-6700k), one of the high-end desktop Skylake chips Intel will ship this fall. (For a general overview of Intel's Skylake announcements, please see our main Skylake launch story (go.pcworld.com/skylakecpu).

Here's what you need to know about Skylake in a nutshell: The prices Intel has published appear to be about the same that it's charging for its Broadwell chips—meaning that, from a price perspective, it's a no-brainer to bypass Broadwell or Haswell for Skylake. But there's a catch for desktop users: Skylake uses a new

> The prices Intel has published appear to be about the same that it's charging for its Broadwell chips—meaning that, from a price perspective, it's a no-brainer to bypass Broadwell or Haswell for Skylake. But there's a catch.

motherboard socket and memory, meaning that you'll practically have to invest wholesale in a new system.

For laptop users Skylake does hit a new, lower, power threshold, so your portable's battery should theoretically last a bit longer.

Intel announced five families of microprocessors at IFA: four for the Core family, as well as new Core m (yes, lowercase *m*) designations for the i3, i5, and i7. If you're buying an Intel-based tablet, chances are it will include a Core Y-series chip. Thin-and-light notebooks will use the U-series chips. So-called "ultimate mobile" systems and performance

workstations will include the H-series chips, while the S-series chips will be included in both performance and value desktops, all-in-ones, and mini PCs.

A quick guide to the charts

We've included Intel's processor charts throughout this story. Just like baseball statistics have evolved from batting average and ERA to WAR and OPS+, so have the metrics Intel uses to describe its processors. Price, clock speed, and the number of cores still remain as the primary metrics. Just note that the price Intel is quoting is for a bulk order in lots of 1,000. You'll typically pay more for an individual chip initially.

(And while this may sound obvious, here's a handy tip: Almost all

Intel's high-end Skylake desktop lineup.

6th Gen Intel® Core™ Desktop Processor SKU Detail (91W)

Processor Number	Cores/Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	DDR4 Memory Speed Support (MHz)	DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel SIPP	Intel SBA	Intel Technologies					Package Type	1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)										Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Core™ i7 Processors (S-Processor Line)																					
i7-6700K	4/8	4.0	4.2	4.0	4.0	Intel HD graphics 530	350/1150	2133	1600	8M	91W	100	2015	✓			✓	✓	✓	LGA	BOX $350.00 TRAY $339.00
Intel® Core™ i5 Processors (S-Processor Line)																					
i5-6600K	4/4	3.5	3.9	3.8	3.6	Intel HD graphics 530	350/1150	2133	1600	6M	91W	100	2015	✓			✓	✓	✓	LGA	BOX $243.00 TRAY $242.00

6th Gen Intel® Core™ Desktop Processor SKU Detail (65W)

Processor Number	Cores/Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	DDR4 Memory Speed Support (MHz)	DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel SIPP	Intel SBA	Intel Technologies					Package Type	1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)										Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Core™ i7 Processors (S-Processor Line)																					
i7-6700	4/8	3.4	4.0	3.9	3.7	Intel HD graphics 530	350/1150	2133	1600	8M	65W	100	2015	✓	✓	✓	✓	✓	✓	LGA	BOX $312.00 TRAY $303.00
Intel® Core™ i5 Processors (S-Processor Line)																					
i5-6600	4/4	3.3	3.9	3.8	3.6	Intel HD graphics 530	350/1150	2133	1600	6M	65W	100	2015	✓	✓	✓	✓	✓	✓	LGA	BOX $224.00 TRAY $213.00
i5-6500	4/4	3.2	3.6	3.5	3.3	Intel HD graphics 530	350/1050	2133	1600	6M	65W	100	2015	✓	✓	✓	✓	✓	✓	LGA	BOX $202.00 TRAY $192.00
i5-6400	4/4	2.7	3.3	3.3	3.1	Intel HD graphics 530	350/950	2133	1600	6M	65W	100	2015	✓			✓	✓	✓	LGA	BOX $187.00 TRAY $182.00
Intel® Core™ i3 Processors (S-Processor Line)																					
i3-6320	2/4	3.9	N/A	N/A	NA	Intel HD graphics 530	350/1150	2133	1600	4M	47W	100					✓			LGA	BOX $157.00 TRAY $149.00
i3-6300	2/4	3.8	N/A	N/A	NA	Intel HD graphics 530	350/1150	2133	1600	4M	47W	100				✓	✓	✓	LGA	BOX $147.00 TRAY $138.00
i3-6100	2/4	3.7	N/A	N/A	NA	Intel HD graphics 530	350/1050	2133	1600	3M	47W	100				✓	✓	✓	LGA	BOX $117.00 TRAY $117.00

6th Gen Intel® Core™ Desktop Processor SKU Detail (35W)

Processor Number	Cores/Threads	Base Freq (GHz)	Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)	Graphics	Graphics Base / Max Freq (MHz)	DDR4 Memory Speed Support (MHz)	DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel SIPP	Intel SBA	Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI	Package Type	1ku Pricing
Intel® Core™ i7 Processors (S-Processor Line)																					
i7-6700T	4/8	2.8	3.6	3.5	3.4	Intel® HD graphics 530	350/1100	2133	1600	8M	35W	100	2015	✓	✓	✓	✓	✓	✓	LGA	TRAY: $303.00
Intel® Core™ i5 Processors (S-Processor Line)																					
i5-6600T	4/4	2.7	3.5	3.4	3.3	Intel® HD graphics 530	350/1100	2133	1600	6M	35W	100	2015	✓	✓	✓	✓	✓	✓	LGA	TRAY: $213.00
i5-6500T	4/4	2.5	3.1	3.0	2.8	Intel® HD graphics 530	350/1100	2133	1600	6M	35W	100	2015	✓	✓	✓	✓	✓	✓	LGA	TRAY: $192.00
i5-6400T	4/4	2.2	2.8	2.7	2.5	Intel® HD graphics 530	350/950	2133	1600	6M	35W	100		✓			✓	✓	✓	LGA	TRAY: $182.00
Intel® Core™ i3 Processors (S-Processor Line)																					
i3-6300T	2/4	3.3	N/A	N/A	NA	Intel® HD graphics 530	350/950	2133	1600	4M	35W	100		✓			✓	✓	✓	LGA	TRAY: $138.00
i3-6100T	2/4	3.2	N/A	N/A	NA	Intel® HD graphics 530	350/950	2133	1600	3M	35W	100		✓			✓	✓	✓	LGA	TRAY: $117.00

sixth-generation Core chips—aka the "Skylake" family—use a *6* as the first number of their product name, such as the i5-6500T.)

Modern operating systems like Windows 10 are better at divvying up tasks among the multiple cores that most processors include, so a greater number of cores and threads generally translates into improved performance. If necessary, those cores can kick into "turbo mode," temporarily overclocking themselves to complete a task quickly. Core i3 chips lack this capability.

Consumers shouldn't have to worry about Intel's Stable Image Platform (SIPP) or Small Business Advantage (SBA) technologies. Ditto for Intel vPro. You might want to consider buying a chip with Intel TXT technology built in, however; that's the Trusted eXecution Environment which seems to be at the heart of new Windows technologies such as Windows Hello (go.pcworld.com/w10helloworks) and Passport. Virtually all of the new Skylake chips include virtualization technology—a geeky way to test out a future version of Windows 10, but essential if you want to run Android apps on your PC (go.pcworld.com/pcandroidapps).

Note: Not everything Intel announced at IFA will be immediately available. (If the price is listed as "To Be Determined," (TBD) Intel will ship it at a later date—either during the fourth quarter or in early 2016.)

High-end desktops: the S series

While Intel hasn't announced any of its high-end "Extreme Edition" parts yet, the first thing that should strike you is the overall reduction in power, although it may not seem apparent initially.

An Intel 4GHz Core i7-4790K Haswell CPU, for example, is rated to dissipate 88 watts of heat. Its direct replacement is the 4GHz Core i7-6700K, which has a "TDP" rating of 91 watts. Both of these CPUs are designed for enthusiasts who will overclock.

The better comparison would be the 3.6GHz Core i7-4790 chip that doesn't overclock. Even with its lower clock speeds, it maintains the same TDP rating of 84 watts. For Skylake, the 3.4GHz Core i7-6700 that can't be overclocked has a TDP rating of 65 watts. To be fair to Haswell, there was a Core i7-4790S version with the same TDP rating as its Skylake counterpart, but the clocks drop even lower, to 3.2GHz.

Even though Skylake represents a processor redesign and not a process shrink—where most of the power reduction takes place— Skylake should consume less power than a similar Haswell chip.

The other thing to notice is that, at least for now, all of the desktop chips that Intel has announced have at most four cores and eight

6th Gen Intel® Core™ Desktop Processor SKU Detail (65W)

Processor Number	Cores/ Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	DDR4 Memory Speed Support (MHz)	DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel Technologies							Package Type	1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)								Intel vPro	Intel SIPP	Intel SBA	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Pentium® Processors (S-Processor Line)																					
G4520	2/2	3.6	N/A	N/A	NA	Intel® HD graphics 530	350/1050	2133	1600	3M	47W	100				✓	✓	✓	✓	LGA	BOX $133.00 TRAY: $86.00
G4500	2/2	3.5	N/A	N/A	NA	Intel® HD graphics 530	350/1050	2133	1600	3M	47W	100				✓	✓	✓	✓	LGA	BOX $82.00 TRAY: $73.00
G4400	2/2	3.4	N/A	N/A	NA	Intel® HD graphics 510	350/1050	2133	1600	3M	47W	100				✓	✓	✓	✓	LGA	BOX $64.00 TRAY: $64.00

6th Gen Intel® Core™ Desktop Processor SKU Detail (35W)

Processor Number	Cores/ Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	DDR4 Memory Speed Support (MHz)	DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel Technologies							Package Type	1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)								Intel vPro	Intel SIPP	Intel SBA	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Pentium® Processors (S-Processor Line)																					
G4500T	2/2	3.0	N/A	N/A	NA	Intel® HD graphics 530	350/950	2133	1600	3M	35W	100				✓	✓	✓	✓	LGA	TRAY: $75.00
G4400T	2/2	2.9	N/A	N/A	NA	Intel® HD graphics 510	350/950	2133	1600	3M	35W	100				✓	✓	✓	✓	LGA	TRAY: $64.00

Intel® Xeon® Mobile Processor SKU Detail (45W)

Processor Number	Cores/Threads	Base Freq (GHz)	Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)	Graphics	Graphics Base/Max Freq (MHz)	LPDDR3 Memory Speed Support (MHz)	DDR3L/DDR4 Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel SIPP	Intel SBA	Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI	Package Type	1ku Pricing
Intel® Xeon® Processors (H-Processor Line)																					
E3-1535M v5	4/8	2.9	3.8	3.6	3.4	Intel HD graphics P530	350/1050	1866	1600/2133	8M	45W	100	2015	✓	✓	✓	✓	✓	✓	BGA	$623
E3-1505M v5	4/8	2.8	3.7	3.5	3.3	Intel HD graphics P530	350/1050	1866	1600/2133	8M	45W	100	2015	✓	✓	✓	✓	✓	✓	BGA	$434

6th Gen Intel® Core™ Mobile Processor SKU Detail (45W)

Processor Number	Cores/Threads	Base Freq (GHz)	Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)	Graphics	Graphics Base/Max Freq (MHz)	LPDDR3 Memory Speed Support (MHz)	DDR3L/DDR4 Memory Speed Support (MHz)	L3 Cache	TDP	Tj (deg)	Intel SIPP	Intel SBA	Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI	Package Type	1ku Pricing
Intel® Core™ i7 Processors (H-Processor Line)																					
i7-6920HQ	4/8	2.9	3.8	3.6	3.4	Intel HD graphics 530	350/1050	1866	1600/2133	8M	45W	100	2015	✓	✓	✓	✓	✓	✓	BGA	$568
i7-6820HQ	4/8	2.7	3.6	3.4	3.2	Intel HD graphics 530	350/1050	1866	1600/2133	8M	45W	100	2015	✓	✓	✓	✓	✓	✓	BGA	$378
i7-6820HK	4/8	2.7	3.5	3.4	3.2	Intel HD graphics 530	350/1050	1866	1600/2133	8M	45W	100		✓		✓	✓		✓	BGA	$378
i7-6700HQ	4/8	2.6	3.5	3.3	3.1	Intel HD graphics 530	350/1050	1866	1600/2133	6M	45W	100		✓		✓	✓		✓	BGA	$378
Intel® Core™ i5 Processors (H-Processor Line)																					
i5-6440HQ	4/4	2.6	3.5	3.3	3.1	Intel HD graphics 530	350/950	1866	1600/2133	6M	45W	100	2015	✓	✓	✓	✓	✓	✓	BGA	$250
i5-6300HQ	4/4	2.3	3.2	3.0	2.8	Intel HD graphics 530	350/950	1866	1600/2133	6M	45W	100		✓		✓	✓		✓	BGA	$250
Intel® Core™ i3 Processors (H-Processor Line)																					
i3-6100H	2/4	2.7	2.7	2.7	NA	Intel HD graphics 530	350/900	1866	1600/2133	3M	35W	100		✓		✓	✓		✓	BGA	$225

threads. Intel's Core i7-5820K and higher "Haswell-E" chips that use larger sockets and don't contain integrated graphics all contain 6 cores and 12 threads. It's not clear whether Intel plans to add similar parts in the future, or leave a 4-core/8-thread as the high end in the smaller socket.

What does seem clear, though, is that are only single Core i5 and Core i7 unlocked "K" versions of the Skylake parts; it's virtually assured that more will be added over time.

From a graphics perspective, the desktop chips are virtually identical: They all use the new Intel HD Graphics 530 core. Just be aware that some of the slower chips—the i5-6400, specifically—have their graphics cores

Intel's mobile Skylake chips include the intriguing mobile Xeon and an over-clockable Core i7.

clocked lower under load. Still to come are Intel's Skylake chips using embedded DRAM, which should greatly increase graphics performance.

The desktop Pentium chips

Intel resuscitated the Pentium brand awhile back, a seemingly odd throwback to the days not too long past when gamers had to tweak HIMEM.SYS and other system files to allow their PCs to work. Today, an Intel Pentium is synonymous with low cost. Intel will also launch Celeron versions of Skylake in the future, at an even cheaper price.

You can see that buying a Pentium isn't that bad of a deal for basic computing. Here's the interesting thing, though: Because there's no Turbo Boost self-overclocking mode, the Pentiums are actually clocked faster than some of their Core cousins. Couple that with a pared-down cache to save cost, and the result is a cheap chip that's going to run at full speed fairly aggressively. The only caveat is the lack of Hyper-Threading, which is Intel's virtual CPU technology that makes two CPU cores act like four. Depending on what you do though, you may not feel it.

And no, cheap gamers, we asked: Intel said none of the new Skylake Pentiums support overclocking, like it did with the "Anniversary Edition" Pentium G3258.

Intel can't shave as much power in the mobile space, where the

6th Gen Intel® Core™ Mobile Processor SKU Detail (28W)

Processor Number	Cores/ Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	LPDDR3 Memory Support (MHz)	DDR3L/ DDR4 Memory Speed Support (MHz)	L3 Cache	TDP	cTDP Down	Tj (deg)	Intel SIPP	Intel Technologies					Package Type	1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)										Intel xPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Core™ i7 Processors (U-Processor Line)																					
i7-6567U	2/4	3.3	3.6	3.4	N/A	Intel® Iris™ Graphics 550	300/1100	1866	1600/2133	4MB	28W	23W	100				✓	✓	✓	BGA	TBD
Intel® Core™ i5 Processors (U-Processor Line)																					
i5-6287U	2/4	3.1	3.5	3.3	N/A	Intel® Iris™ Graphics 550	300/1100	1866	1600/2133	4MB	28W	23W	100				✓	✓	✓	BGA	TBD
i5-6267U	2/4	2.9	3.3	3.1	N/A	Intel® Iris™ Graphics 550	300/1050	1866	1600/2133	4MB	28W	23W	100				✓	✓	✓	BGA	TBD
Intel® Core™ i3 Processors (U-Processor Line)																					
i3-6167U	2/4	2.7	N/A	N/A	N/A	Intel® Iris™ Graphics 550	300/1000	1866	1600/2133	3MB	28W	23W	100				✓	✓	✓	BGA	TBD

6th Gen Intel® Core™ Mobile Processor SKU Detail (15W)

Processor Number	Cores/ Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	LPDDR3 Memory Speed Support (MHz)	DDR3L/ DDR4 Memory Speed Support (MHz)	L3 Cache	TDP	cTDP Down	TJ (deg)	Intel SIPP	Intel Technologies					Package Type	Tku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)										Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Core™ i7 Processors (U-Processor Line)																					
i7-6650U	2/4	2.2	3.4	3.2	N/A	Intel® Iris™ Graphics 540	300/1050	1866	1600/ 2133	4MB	15W	9.5W	100	2016	✓	✓	✓	✓	✓	BGA	TBD
i7-6600U	2/4	2.6	3.4	3.2	N/A	Intel® HD graphics 520	300/1050	1866	1600/ 2133	4MB	15W	7.5W	100	2016	✓	✓	✓	✓	✓	BGA	$393
i7-6560U	2/4	2.2	3.2	3.1	N/A	Intel® Iris™ Graphics 540	300/1050	1866	1600/ 2133	4MB	15W	9.5W	100				✓	✓	✓	BGA	TBD
i7-6500U	2/4	2.5	3.1	3.0	N/A	Intel® HD graphics 520	300/1050	1866	1600/ 2133	4MB	15W	7.5W	100				✓	✓	✓	BGA	$393
Intel® Core™ i5 Processors (U-Processor Line)																					
i5-6360U	2/4	2.0	3.1	2.9	N/A	Intel® Iris™ Graphics 540	300/1000	1866	1600/ 2133	4MB	15W	9.5W	100	2016	✓	✓	✓	✓	✓	BGA	TBD
i5-6300U	2/4	2.4	3.0	2.9	N/A	Intel® HD graphics 520	300/1000	1866	1600/ 2133	3MB	15W	7.5W	100	2016	✓	✓	✓	✓	✓	BGA	$281
i5-6260U	2/4	1.8	2.9	2.7	N/A	Intel® Iris™ Graphics 540	300/950	1866	1800/ 2133	4MB	15W	9.5W	100				✓	✓	✓	BGA	TBD
i5-6200U	2/4	2.3	2.8	2.7	N/A	Intel® HD graphics 520	300/1000	1866	1600/ 2133	3MB	15W	7.5W	100				✓	✓	✓	BGA	$281

6th Gen Intel® Core™ Mobile Processor SKU Detail (15W)

Processor Number	Cores/ Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base / Max Freq (MHz)	LPDDR3 Memory Speed Support (MHz)	DDR3L/ DDR4 Memory Speed Support (MHz)	L3 Cache	TDP	cTDP Down	TJ (deg)	Intel SIPP	Intel Technologies					Package Type	Tku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)										Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI		
Intel® Core™ i3 Processors (U-Processor Line)																					
i3-6100U	2/4	2.3	N/A	N/A	N/A	Intel® HD graphics 520	300/1000	1866	1600/ 2133	3MB	15W	7.5W	100				✓	✓	✓	BGA	$281
Intel® Pentium® Processors (U-Processor Line)																					
4405U	2/4	2.1	N/A	N/A	N/A	Intel® HD graphics 510	300/950	1866	1600/ 2133	2MB	15W	10W	100				✓	✓	✓	BGA	TBD

maximum thermal power of a Broadwell chip, 47 watts, is nearly identical to the 45 watts that a mobile Skylake processor consumes. Here, though, Intel is focusing on the time in which the chip needs to be powered up. Intel's Skylake-specific Speed Shift feature reduces the time in which a chip needs to shift from a high-power to a low-power sleep state to as little as 1ms, versus 30ms or so before. This sounds like a tiny detail, but when the chip is constantly shifting from a full-power "busy" state to a sleep state, it's a big deal.

One of the oddities of the new mobile Skylake line is the new mobile Xeon "server" processor, designed for true mobile workstations. Intel has already begun shipping the chip—at the SigGRAPH show in August, Lenovo announced the P50 and P70 workstations, including the chip as well as peripheral enhancements like Thunderbolt 3.0,

All of the 15W Skylake variants prove that Intel certainly believes in the ultrabook market.

based on the new Intel Alpine Ridge controller.

   Gamers, though, may want to think about the Core i7-6820HK. Why? Because it carries that magical *K* suffix, meaning that it's over-clockable. Yes, an overclockable mobile chip! At IDF, Intel executives said we'd be seeing laptops with an easy-peasy, one-touch overclocking mode by way of a "turbo" button.

   In general, though, Intel's mobile chips show a definite progression down the performance curve: The more expensive Core i7s boast larger cache, robust Turbo Modes, and a faster maximum graphics clock speed. All of these factors decline as the processors step down into the Core i5 and Core i3 range.

   Be aware that Intel also has two other lineups of Core i7/i5/i3 for ultrabook PCs consuming 28 and 15 watts. In general, you should expect lower performance but longer battery life with these chips. Because laptops in general are getting thinner by the day, it might not be totally clear whether you're buying an "ultrabook" or just a thin laptop.

   These lower-power chips differ from the more robust 45-watt variants in two key ways: The number of cores are significantly reduced. Also, Intel has included what appears to be a down-clocked

Just 4.5 watts!
That's impressive.

6th Gen Intel® Core™ m Processor SKU Detail

Processor Number	Cores/Threads	Base Freq (GHz)	Intel Turbo Boost Technology 2.0			Graphics	Graphics Base/Max Freq (MHz)	LPDDR3/DDR3L Memory Speed Support (MHz)	L3 Cache	TDP	cTDP Up/Down	TJ (deg)	SDP	TJ @ SDP (deg)	Intel SIPP	Intel Technologies					1ku Pricing
			Max Single Core Turbo (GHz)	Max Dual Core Turbo (GHz)	Max Quad Core Turbo (GHz)											Intel vPro	Intel TXT	Intel VT-d	Intel VT-x	AES-NI	
Intel® Core™ m7 Processors (Y-Processor Line)																					
6Y75	2/4	1.2	3.1	2.9	N/A	Intel HD graphics 515	300/1000	1866/1600	4MB	4.5W	7W/3.5W	100	3W	N/A	2016	✓	✓	✓	✓	✓	$393
Intel® Core™ m5 Processors (Y-Processor Line)																					
6Y57	2/4	1.1	2.8	2.4	N/A	Intel HD graphics 515	300/900	1866/1600	4MB	4.5W	7W/3.5W	100	3W		2016	✓	✓	✓	✓	✓	$281
6Y54	2/4	1.1	2.7	2.4	N/A	Intel HD graphics 515	300/900	1866/1600	4MB	4.5W	7W/3.5W	100	3W					✓	✓	✓	$281
Intel® Core™ m3 Processors (Y-Processor Line)																					
6Y30	2/4	0.9	2.2	2.0	N/A	Intel HD graphics 515	300/850	1866/1600	4MB	4.5W	7W/3.8W	100	3W					✓	✓	✓	$281
Intel® Pentium® Processors (Y-Processor Line)																					
4405Y	2/4	1.5	N/A	N/A	N/A	Intel HD Graphics	300/800	1866/1600	2MB	6W	N/A/4.5W	100	N/A						✓	✓	TBD

mode, for activities like simply displaying a webpage, for example, that require less exertion from a chip.

You'll also notice two graphics variations: a slightly underclocked version of the HD Graphics included on the 45-watt chips, as well as an entirely different Iris Graphics architecture. The Iris Graphics brand has generally been used for Intel's premium graphics product, which means the lower-power products may actually outperform the chips with more cores.

> You'll also notice two graphics variations: a slightly underclocked version of the HD Graphics included on the 45-watt chips, as well as an entirely different Iris Graphics architecture.

(But note the "TBD" designation in the pricing column. Iris Graphics is coming later, and Intel's not saying when.)

If you're wondering why, it's likely because higher-wattage quad-cores are almost always coupled with discrete graphics for more performance. The lower-power U-series chips almost always go it alone with integrated graphics. Still to come will be the Iris Pro version, using its own dedicated 64MB or 128MB eDRAM frame buffer.

One has to wonder whether, over time, Intel might add a 4-core/8-thread version of the 28W Core i7 chip, as a middle ground for gamers. Eventually, the PCI-SIG hopes to mainstream a technology called Oculink, which lets gamers tote around a low-power laptop by day and connect it to an external GPU for gaming after hours.

The Core M (sorry, Core m) now has its own naming scheme

So-called two-in-one or hybrid devices occupy their own little niche: Sometimes they're a tablet, and sometimes they're a notebook. Now, with Intel's new Skylake Core m chips, you'll have a better sense of what's what.

What surprises me most, however, is the price Intel's charging—almost $300 a pop in most cases. That means the Skylake Core m

definitely won't be appearing in devices that will compete with Android tablets. For the price of a Core m, you'd be able to buy a decent Android tablet all by itself.

The Core m, however, features both upclocked and downclocked modes, allowing the tablet to rev up when needed, then clock down when not. (The Core m3 can also enter Turbo Mode, unlike the Core i3.)

While the Intel HD Graphics 515 chip is part of the Skylake family, it's pretty bare-bones in terms of performance. Still, the selling point is power: Core m chips run at just 4.5 watts, and Intel believes you'll get up to ten hours of battery life with a Core m tablet.

Know your chips to make the best purchase

If you've read this far, you should have a better idea of what distinguishes which Intel Skylake chip from another. It's useful information, because eventually, you're going to see an ad or a sign advertising a "Core i7" computer on heavy discount, and you're going to be tempted. You should be able to figure out whether the vendor is selling an older Broadwell chip, or perhaps a low-end Core i3 that isn't what you'll want.

Remember, too, that Intel's Skylake is more than just a chip—it's also a collection of technologies designed to revamp the PC. ⏻

You might know **Joshua**.
He loves video games, and he
owns enough to know they're not
all meant for kids. That's why he
reminds his friends (at least the
ones that have kids) that they all
have **big black letters on the box**
to help parents find the ones that
are best for their families.

You can learn about those
ratings at **ESRB.org**

Los Angeles, CA

Surface Pro 3 vs. iPad Pro: What Apple's copied, what it does better

BY MARK HACHMAN

AFTER LAUNCHING A LARGER iPhone 5 Plus last year that mimicked phablets like the Lumia 1520, Apple has taken another page from Microsoft's playbook with the Apple iPad Pro—which now includes a Surface-like keyboard and stylus.

Apple's new iPad Pro—available from $799 to $1079, with storage ranging from 32GB to 128GB—will be available this November, a bit

after the reported introduction of the Surface Pro 4. But for right now, the comparisons between it and the Surface Pro 3 are undeniable.

Before we dive into the hardware specs, let's make one key software difference clear: The iPad Pro still runs iOS, instead of the full Windows desktop OS you can use on a Surface Pro. For many power users, that's the difference between an accessory and an essential piece of equipment.

On the hardware side, two elements—the so-called Smart Keyboard and the Apple Pencil—are going to have Microsoft Surface fans whooping with glee. (They will be sold separately, as is the case with the Surface Pro 3's accessories.)

Because the iPad still lacks a kickstand, the Smart Keyboard copies the foldover "origami" keyboard of Amazon's tablets. Like the Surface, it connects to the tablet through three metal bumps, which transmit data as well as power. Unlike Microsoft's Type Cover, the keyboard lies flat on the tabletop; and, like the Touch Cover, it's made of fabric as well—an improvement on typing directly on glass, but probably not much. The keyboard will be available for $169, in November.

And then there's the Apple Pencil, a $99 stylus that's really long—

Doesn't this Apple Smart Keyboard look familiar?

about the length of an ordinary #2 pencil, it appears. It's far longer than the stylus that ships with the Surface Pro 3 tablets, and it appears to lack a loop or even a docking port to connect to the tablet. It does, however, include a Lightning connector for charging.

Apple's Schiller claimed that the iPad Pro and the new Pencil worked together to give the impression of nearly latency-free inking, supporting different levels of inking pressure. It has the precision to "touch a single pixel," Schiller claimed.

To support his claims, Schiller brought on stage executives from Microsoft—to show off Office for the iPad—and Adobe, which demonstrated apps like Adobe Fix, allowing graphic artists to manipulate images digitally on the iPad.

The Apple Pencil in action.

Where the iPad Pro does better

In other ways, the iPad Pro jumps ahead of the Surface Pro 3. For starters it's slightly larger, at 12.9 inches versus 12 inches. Apple hasn't said how much memory is inside it, but Apple senior vice president of product marketing Phil Schiller said that the tablet includes a more powerful 64-bit A9X chip that's faster than 80 percent of the PCs shipped in the last 12 months, and 90 percent more powerful, graphically.

The display boasts a higher resolution than the Surface Pro 3 as well: 2732 x 2048 pixels versus the 2160 x 1440 display offered by the Surface Pro 3. The battery life is a tad higher: 10 hours, versus 9 hours for the Surface Pro 3. Apple even showed off multitasking, dividing the screen between two different windows that could run different tasks.

For now, the iPad Pro's hardware specs are arguably a tad superior to the Surface Pro 3's. But while Apple may claim to have "reinvented" the idea of a productivity tablet with the iPad Pro, Surface owners know where Apple found its biggest ideas. We expect Microsoft to one-up Apple yet again with the Surface Pro 4. ⏻

Oh boy, multitasking! But not quite in…windows.

23
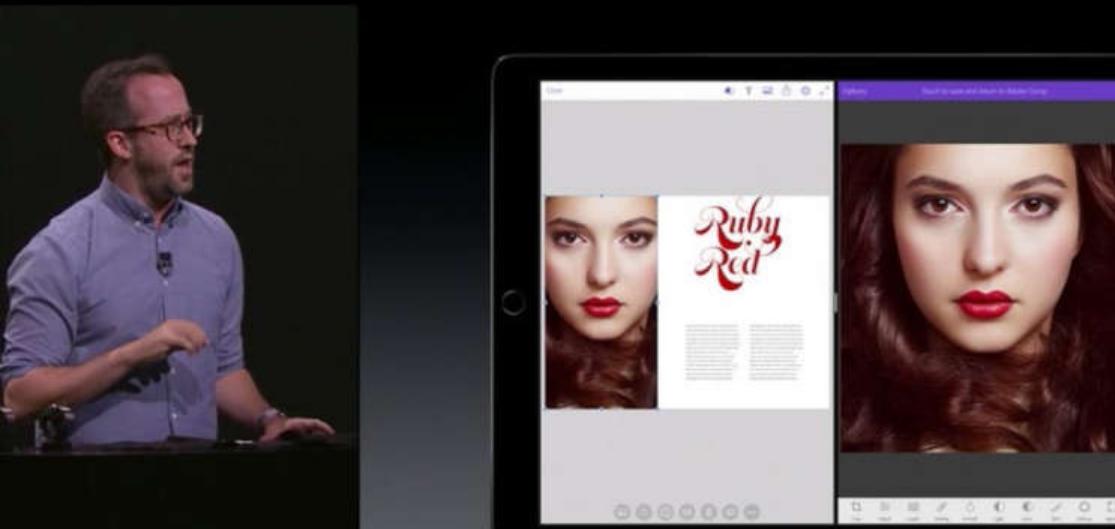
Microsoft unveils new Office for iPad features on Apple's stage

BY BLAIR HANLEY FRANK

IN A SURPRISE MOVE, Microsoft sent a pair of representatives to Apple's big press event in San Francisco early in September to demonstrate new features in Office for iOS that are tailored for the new iPad Pro.

Kirk Koenigsbauer, Microsoft's corporate vice president of Office 365 client applications, came on stage at the Bill Graham Civic Auditorium

to show new changes to the company's suite of apps for Apple's tablet, including the ability to draw freehand shapes on a Word or PowerPoint document, and then get them translated into shapes like arrows or circles.

It's designed to take advantage of Apple's new Pencil stylus for the iPad Pro, a $99 accessory the company announced just ahead of Koenigsbauer's appearance on stage. Users can also draw annotations on documents, and have those annotations sync across Office apps on iOS and other platforms. Microsoft didn't say whether those inking features will require the iPad Pro and Pencil, or if they'll also be available to other iPad users.

In addition, the apps can take advantage of the new iPad multitasking features in iOS 9 to let users copy and paste content

across different Office apps running side by side. That means users can take a chart from an Excel spreadsheet that they're looking at on the right-hand side of an iPad Pro or iPad Air 2's screen, and copy it to a Word document that's taking up the left half of the device's screen real estate.

Having Office on the iPad Pro should help Apple attract the interest of enterprise users who might consider purchasing its new tablet for use in the workplace. Apple is competing against Microsoft in that arena, partnering with IBM and Cisco to turn iPads into compelling business devices. Meanwhile, Dell, HP, and others recently agreed to

sell Surface Pro tablets as part of their enterprise sales efforts.

Interestingly, Apple didn't show off its iWork productivity suite, which the company bundles with iOS devices. iWork's Pages, Numbers, and Keynote apps compete directly with Word, Excel, and PowerPoint, though Apple doesn't spend nearly as much time discussing and promoting them as Microsoft does with its Office suite.

When users search for information using the iPhone and iPad's Intelligent Search feature in iOS 9, it will also pull up notes stored in Microsoft OneNote, and emails from Outlook alongside relevant content from the Web and other sources.
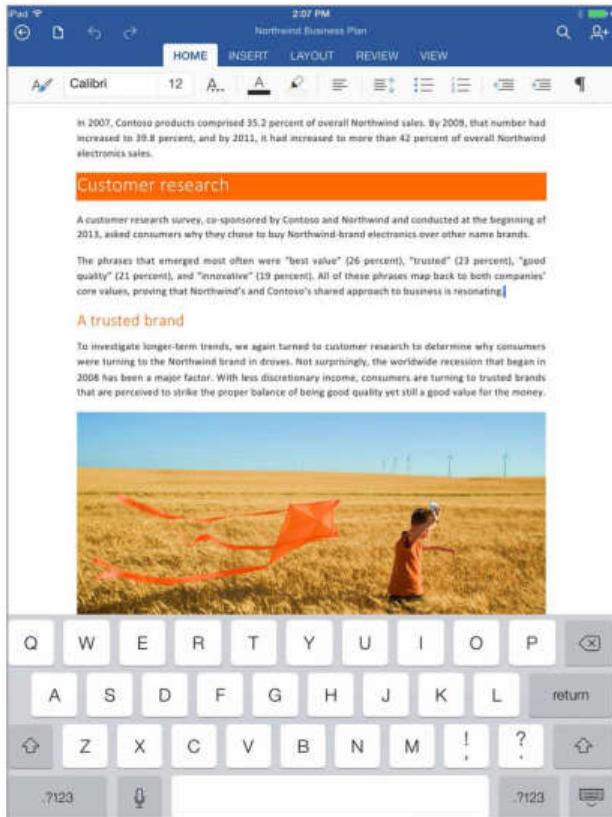
On top of all the Office for iPad news, Microsoft also announced new features for two of its Apple Watch apps. Users of the Outlook app for iPhone and Apple Watch will be able to view appointment data as one of the complications on a watch face, and scroll through past and future events by rotating the digital crown.

The Microsoft Translator app can also bring key translated phrases to a user's watch face, and will adjust those phrases to match the location and time of day. That way, it will show how to say "good morning" first thing in the day and "good afternoon" as time moves on.

Koenigsbauer's appearance is another sign of Microsoft's new strategy under CEO Satya Nadella. The company has put significant effort into building apps for platforms it doesn't control, including versions of Office for iOS and Android. Cross-platform use even extends to Microsoft's executives: Koenigsbauer was conspicuously wearing an Apple Watch on stage, rather than one of Microsoft's Bands.

All of the updates that Microsoft announced at this Apple special event will be available when iOS 9 and watchOS 2 launch. ⏻
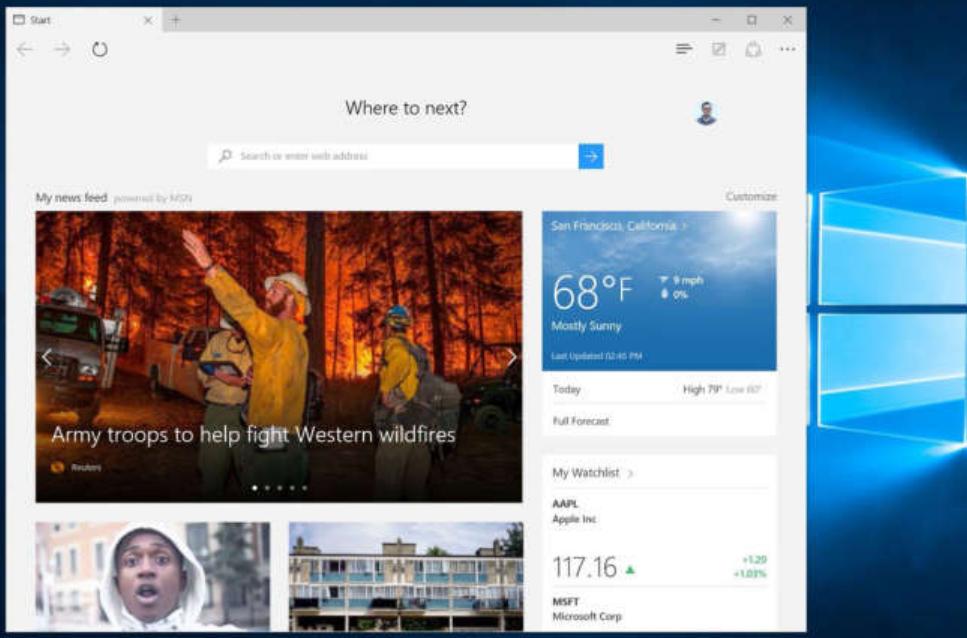
Windows 10 is catching up to Windows 8.1, report says

BY JARED NEWMAN

WINDOWS 10 ADOPTION hasn't caught up with Windows 8.1 yet, but it may be getting close.

According to AdDuplex, the split between Windows 8.1 and Windows 10 devices is currently 61 percent for the former, and 39 percent for the latter. If you don't count Windows RT devices such as Microsoft's Surface tablets, the ratio is 58.8 percent for Windows 8.1 to 41.2 percent for Windows 10. The data comes from 173 Windows Store that use AdDuplex for cross-promotional ads.

Granted, this is hardly a complete measure of Windows 10 usage, as AdDuplex isn't even counting devices that run Windows 8.0 or earlier. As we know from other metrics firms, Windows 7 is still the dominant

Windows Versions (minus Windows RT)
September 8th, AdDuplex

adduplex

If we discount Windows RT tablets (primarily Surface RT and Surface 2), we see that the share is even more impressive.

Windows 10
41.2%
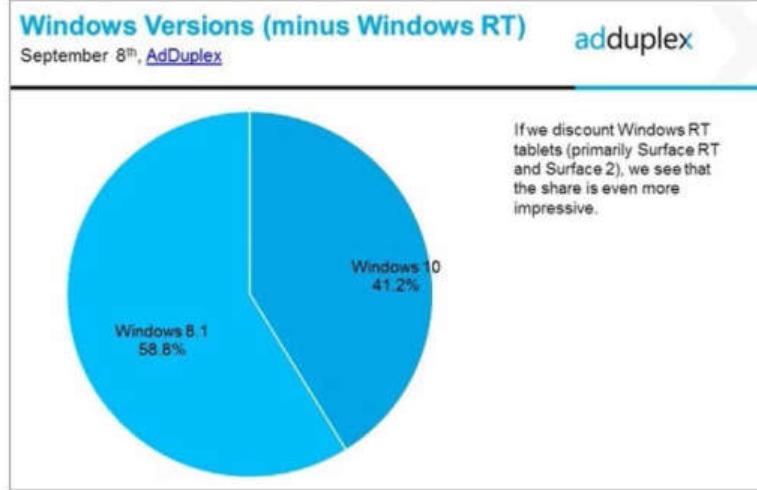
Windows 8.1
58.8%

version of Microsoft's operating system, running on roughly half of all laptops, desktops, and tablets.

In last month's market share data from NetMarketShare and StatCounter, Windows 10 was still far from overtaking even Windows 8.1. NetMarketShare showed a 69-31 split between the older and newer operating systems, while StatCounter found a 73-27 split.

In terms of user numbers, Microsoft itself has said Windows 10 was installed on 75 million machines after four weeks. Thanks to the free upgrades Microsoft is offering to consumers running Windows 7 or higher, adoption has been faster than for any previous version of Windows.

Why this matters: AdDuplex's data is useful in showing how quickly devices with the Windows Store are moving to Windows 10. As the balance tilts away from Windows 8.1, developers could have more incentive to update their apps with full Windows 10 support, or even create Universal Apps that can run across phones, tablets, laptop and desktop PCs, and game consoles. ⏻
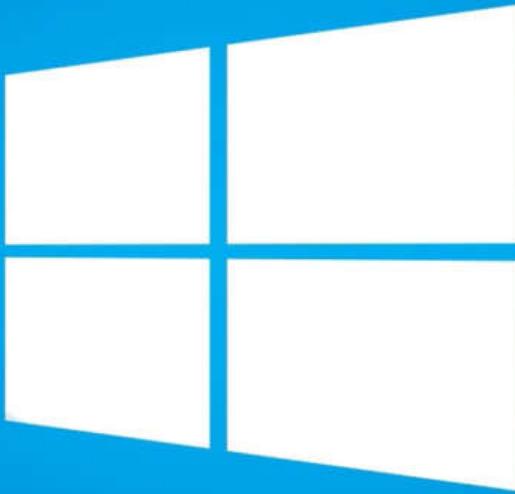
Didn't ask for Windows 10? Your PC may have downloaded it anyway

BY JARED NEWMAN

WHETHER YOU WANT Windows 10 or not, Microsoft says it may download the files to your PC regardless.

In a statement to the *Inquirer*, Microsoft confirmed that it automatically downloads Windows 10 installation files on eligible PCs, provided automatic updates are enabled through Windows Update. The download occurs even if users haven't opted in through the Windows 10 reservation dialog.

"For individuals who have chosen to receive automatic updates through Windows Update, we help upgradable devices get ready for Windows 10 by downloading the files they'll need if they decide to

upgrade," Microsoft told the Inquirer. "When the upgrade is ready, the customer will be prompted to install Windows 10 on the device."

When reached for comment, Microsoft told *PCWorld* that the downloads occurred around the time of Windows 10's July 29 launch.

Why this matters: Microsoft appears to have crossed a line in its zeal to move people onto its latest operating system. Several reports indicate that the Windows 10 files take up as much as 6GB of storage in a hidden folder, potentially hamstringing machines that don't have much free space left. Even worse, users who have strict data caps could face hefty overage charges for a massive download that they didn't even ask for.

> Microsoft appears to have crossed a line in its zeal to move people onto its latest operating system.

Bye-bye bandwidth

PCWorld has also heard from several readers on this issue, including one whose data plan has been affected by the automatic download. The reader, who runs a small computer repair shop, did not reserve Windows 10, yet recently noticed 6GB missing from his main desktop.

Upon further investigation, the reader's daughter—who lives in an area without wired Internet and relies on Verizon Wireless for connectivity—had also automatically downloaded the installation files. "They do not wish to upgrade at this time, as they prefer to stay with Windows 7," the reader said. "But they're four days into their wireless plan, and have used more than half of their allowance because of the Windows 10 download."

The Inquirer also spoke to a reader who said Windows 10 tries to install itself every time the machine is booted. It's unclear if this is typical behavior for those who haven't opted into the upgrade.

This isn't the only instance where Windows 10 has gotten users into trouble with data caps. By default, the system also uses peer-to-peer networking to distribute Windows 10 updates, potentially eating up bandwidth without users' knowledge.

What you can do

It's worth noting that Windows Update provides users with a few auto-install options. Enabling the Important option for updates provides security and stability fixes, while the Recommended updates are meant to improve non-critical issues. There's also a Microsoft Update option for other software such as Office. We've reached out to Microsoft to see which of these tiers enables the auto-download of Windows 10 files.

In the meantime, some users have reported success at removing the files and Windows 10 update prompts by entering the following into the command prompt as an administrator:

`WUSA /UNINSTALL /KB:3035583code>`

This should at least remove Windows 10's update notifications (go.pcworld.com/w10updateno), but we haven't confirmed whether it removes the installation files and prevents further downloads. ⏻

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The 10 coolest, fantastical, and most powerful PC reveals of IFA 2015

BY IAN PAUL

ALL THE BIG NEWS from IFA Berlin 2015 is in and, wow, if this eye-grabbing lineup doesn't help the PC industry make it rain this holiday season, what will?

As a follow-up to the Windows 10 introduction in July, we got details on Intel's latest "Skylake" Core chips, some amazing gaming laptops, a modular PC, a new Compute Stick design, wireless charging for your laptop, and…oh, geez, just check it out—and prepare for a serious case of tech envy.

1. Skylake's full launch

Intel's "Skylake" sixth-generation Core processors (go.pcworld.com/skylake10) are the key to everything that was announced at IFA Berlin. It's kind of like the second act for PCs following Microsoft's introduction of Windows 10. Combined, the WinTel alliance will deliver powerhouse PCs rocking 4K displays, infrared cameras for facial recognition, and gesture-based computing. On top of that, Skylake packs the usual boost in speed and reduction in power consumption typical of new Intel processors.

For all the hard details, see our story on page 8 and the Skylake cheat sheets, which include data on everything from new 91-watt desktop processors down to the 4.5W Core m (formerly Core M) chips and everything in between. We've already reviewed the high-end desktop chips (go.pcworld.com/skylakechips).

2. Asus's liquid-cooled laptop

Laptop? Yeah, right. You'll need a sturdy table for this monster, at least when it's docked to that "gigantic bulbous butt." Asus's GX700 (go.pcworld.com/gx700) gaming notebook comes with an overclocked quad-core Skylake mobile "K" series processor and a 17-inch 4K (3840-by-2160) display, plus it's rocking an as-yet-unreleased Nvidia mobile GPU.

Asus is mostly hush-hush about the laptop, but it appears the water cooling rig is that growth in the back. The clamshell can undock from it for a more portable PC. Hook it up at home, however, and you've got water keeping your components cool so they don't melt under the

stress of Witcher 3 on Ultra settings.

No pricing info yet, but the GX700 should head our way before the end of the year.

3. Acer Predator gaming notebooks

Acer introduced two new gaming notebooks at IFA: the Predator 15 and Predator 17 (go.pcworld.com/predator15). Both laptops pack a Skylake Core i7-6700HQ chip, GTX 980 graphics, up to 32GB of RAM, and a 512GB PCIe SSD. The Predator 15 has a 15.6-inch display with your choice of 1080p or 4K (3840-by-2160) resolution. Acer decided not to follow Asus' lead by packing 4K into a 17-inch screen, opting for 1080p only on the Predator 17.

Acer has also added some neat gamer-centric features, such as a Cooler Master fan module you can slap into the optical drive bay for extra cooling during intense gaming sessions. The Predator gaming rigs are priced at $1,500 and $1,600 for the 15- and 17-inch models, respectively, and roll out in November.

4. Acer Revo Build

We've already seen a Lego-inspired modular computer (go.pcworld.com/legopc), now Acer is coming out with its own stackable PC that snaps together. The Acer Revo Build mini PC (go.pcworld.com/acerrevo) uses pogo pins and magnetic alignment to join modules together.

The base unit is contained in a 1-liter chassis with a 4.92-by-4.92-inch footprint. Modules—which Acer calls "blocks"—include an external hard drive in 500GB or 1TB sizes, a wireless charger, and an audio module with speakers and microphone. Acer promises more blocks to come.

U.S. pricing and availability for the Revo Build were not announced. In fact, Acer's not even sure it will get here. Nevertheless, it's a cool concept, and there's always Amazon and eBay if you really want this PC.

5. Acer's Windows 10 PC Phone

Acer is the first company to take up Microsoft's challenge to use Windows 10 Mobile's Continuum feature to transform your phone into an ad hoc PC, but it won't be the last. Acer's slick Jade Primo (go. pcworld.com/jadeprimo) packs a 5.5-inch AMOLED display, a 21-megapixel rear-facing camera with dual flash, and an 8MP front-facing camera, all supported by Qualcomm's Snapdragon 808

processor. The Primo will also have an optional dock to connect to an external monitor over HDMI for that PC-like experience powered by your phone and Windows 10's universal apps (go.pcworld.com/universalapps).

True, there have been a few phones to try this trick in the past, such as the Motorola Atrix. Continuum's a highlight feature for Windows 10 Mobile, though, so expect to see at least a few more "PC phones" in the next year—including new flagship Lumias (go.pcworld.com/lumias) from Microsoft itself.

6. Lenovo Miixes it up with Surface

It took the Microsoft Surface three generations to achieve its original aims (go.pcworld.com/surfacevision), but there's no question it was a solid concept from day one. Lenovo appears to agree, as it's…er…borrowing some Surface concepts for the Ideapad Miix 700 (go. pcworld.com/lenovomiix) rolling out in November, with prices starting at $700.

This 12-inch, 2-in-1 tablet can hold up

to a Skylake Core i7 processor, maxes out at 8GB of RAM, and offers a 256GB SSD, an LTE upgrade, and an optional Intel RealSense 3D camera. There's also a Lenovo Keyboard Folio accessory to convert the tablet to a laptop.

The Miix 700 was only one small part of Lenovo's avalanche of announcements. From the Ideacentre AIO 700 to Skylake-toting ThinkPad Yoga convertibles, check out the rest of Lenovo's Windows PC blitz at IFA (go.pcworld.com/ifa15lenovo).

7. Intel's Core m Compute Stick

Forget about pipsqueak Atom processors. Intel's next Compute Stick (go.pcworld.com/computerstick) design—which turns your HDTV into a PC via HDMI—will come rocking a Skylake-based Core m processor.

The change is thanks to Skylake's extreme scalability, which allows it to power 90W desktop processors all the way down to the puny 4.5W Core m. Even better, this Compute Stick will be able to display 4K video. Talk about a pocket rocket.

8. Asus's audacious home router

Google isn't the only company rethinking the router (go.pcworld.com/routerrethink). At IFA, Asus introduced the RT-AC5300U (go.pcworld.com/rtac5300u), a powerful 4x4 home router that can broadcast two 5GHz 802.11ac networks with TCP throughput maxing out at 2165Mbps each. There's also a single 2.4GHz 802.11n network that gets 1000Mbps of TCP throughput. Simply put, it looks like this will be the most powerful consumer router ever when it launches later this year.

When you're not connecting to the

Internet, this claw-shaped monster also doubles as a coaster for your Klingon blood wine. Well, not really, but it sure looks like it could. Kaplah!

9. Intel goes wireless

Intel's push for a cable-free future for the PC continued at IFA with a new way to wirelessly charge your laptop (go.pcworld.com/ wirelesscharge) in 2016. The system doesn't have a name yet, but it's the result of merging standards from the Alliance for Wireless Power and the Power Matters Alliance. When it hits the market, Intel aims for it to deliver up to 20 watts of power to your device—double the amount of power delivered by most current wall adapters for tablets.

Intel also used IFA to show off WiGig, a wireless gigabit data link for connecting monitors, hard drives, and other peripherals. WiGig is currently supported by Dell and Hewlett-Packard.

10. Toshiba's impressive Satellite

Toshiba held nothing back in the convertible Satellite Radius 12 (go.pcworld.com/satelliteradius12) laptop. This powerful 12.5-inch road warrior could give Lenovo's X series a run for its money—at least on the spec sheet.

The top-notch model of this PC includes an IPS touchscreen display with 3840-by-2160 4K resolution, Technicolor-certified color accuracy, an infrared camera for use with Windows Hello (go.pcworld.com/ helloworks), and, of course, a Skylake processor. That's basically everything you could ask for in a Windows 10 laptop.

Toshiba hasn't revealed pricing yet, but look for the Radius 12 to roll out before the end of the year. ⏻
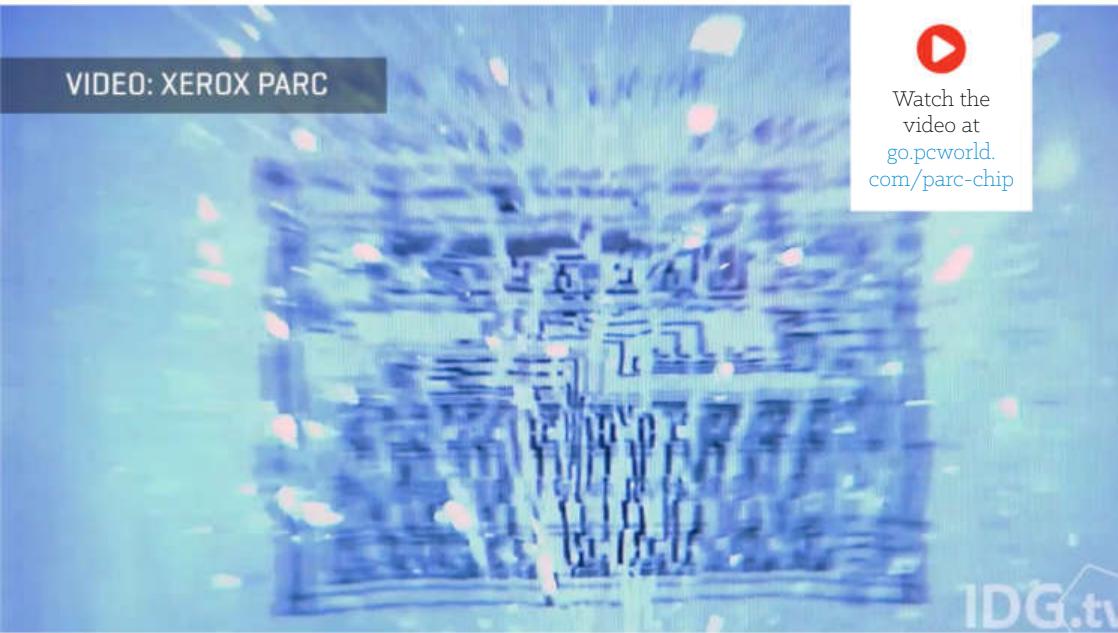
VIDEO: XEROX PARC

Watch the video at go.pcworld. com/parc-chip

Xerox PARC's new chip will self destruct in 10 seconds

BY MARTYN WILLIAMS

ENGINEERS AT XEROX PARC have developed a chip that will self-destruct upon command, providing a potentially revolutionary tool for high-security applications.

The chip, developed as part of DARPA's vanishing programmable resources project, could be used to store data such as encryption keys and, on command, shatter into thousands of pieces so small, reconstruction is impossible. (See the demo in the video above.)
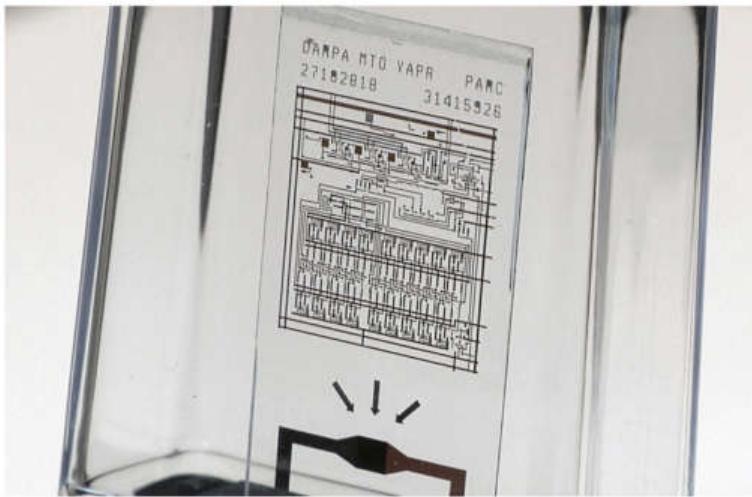
A chip fabricated on a glass substrate shortly before destruction during a demonstration at DARPA's Wait, What? conference in St. Louis, Missouri, on Sept. 10, 2015.

It was demonstrated at DARPA's Wait, What? event in St. Louis, Missouri, on September 10.

"The applications we are interested in are data security and things like that," said Gregory Whiting, a senior scientist at PARC in Palo Alto, California. "We really wanted to come up with a system that was very rapid and compatible with commercial electronics."

The result is a chip based on Gorilla Glass, the Corning-produced tough glass used in the displays of numerous smartphones.

"We take the glass and we ion-exchange temper it to build in stress," said Whiting. "What you get is glass that, because it's heavily stressed, breaks it fragments into tiny little pieces."

In a demonstration on Thursday, the glass was stressed to breaking point by heat. When a circuit was switched on, a small resistor heated up and the glass shattered into thousands of pieces. Even after it broke up, stress remained in the fragments and they continued breaking into even smaller pieces for tens of seconds afterward.

The chip presents an exciting prospect in applications such as computer security. If a chip fabricated on glass was used to store an encryption key, the destruction of the chip could assure complete

Shards of glass is all that's left of a self-destructing chip during a demonstration at DARPA's Wait, What? conference in St. Louis, Missouri, on Sept. 10, 2015.

destruction of the key in an instant—perhaps as part of a routine process or when the key falls into the wrong hands.

During the demo in St. Louis, the self-destruct circuit was triggered by a photo-diode, which switched on the circuit when a bright light fell on it. In this occasion, the light was provided by a laser, but the trigger could be anything from a mechanical switch to a radio signal. ⏻

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Samsung's new RAM heralds the dawn of 6GB smartphones

BY IAN PAUL

IN DECEMBER 2014, Samsung rolled out a new type of mobile DRAM that would allow smartphones to carry up to 4GB of volatile memory. Less than a year later, Samsung says it's getting ready to cram up to 6GB of RAM into our handsets.

The increased RAM comes courtesy of Samsung's mass production of 12 gigabit LPDDR4 (low power, double-data-rate 4) mobile DRAM. The new memory is being produced using Samsung's 20-nanometer (nm) process.

Samsung says the new DRAM is 30 percent faster than the previous 20nm-based 8Gb LPDDR4 and twice as fast as DDR4 DRAM for PCs.
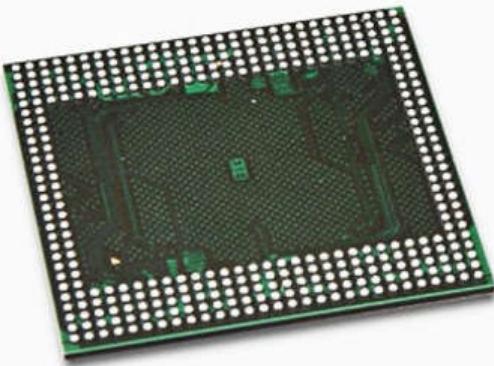
The new mobile memory means a single package can use two chips to carry 3GB of RAM or four chips for 6GB. This will not only result in premium smartphones packing more RAM, but smaller phones won't have to skimp on memory due to size constraints.

It's not clear when we'll start to see smartphones packing the new RAM. Right now, most phones use 3GB, and Apple packs just 1GB of RAM into the iPhone 6 Plus. Whether we

> The new mobile memory means a single package can use two chips to carry 3GB of RAM or four chips for 6GB.

need more memory in our phones right now is unclear, but no doubt developers will make use of the added RAM over time.

Why this matters: Samsung sees a future for its LPDDR4 DRAM beyond the smartphone and tablet markets where it's currently called for. In the coming years, the company hopes to see Ultrabooks, digital appliances, and even auto tech packing the new DRAM. For now, however, it's all about increasing the memory capability of mobile devices to support multitasking and more-powerful apps. ⏻

How to reclaim your privacy in Windows 10, piece by piece

Windows 10 shares a lot of data with Microsoft in order to create a seamless experience across devices. If you lean more toward privacy, here's how to disable all of it.

BY IAN PAUL

THERE'S NO DOUBT about it: Windows 10 is studded with data-tracking tidbits and hooks into all sorts of Microsoft online services. Handing over all that data has some tangible benefits, like Windows 10's OneDrive integration and the Bing-powered brains behind the Cortana digital assistant, but not everyone is thrilled with the idea of an operating system that's constantly looking over their digital shoulder.

Don't fret. I'm here to show you how to get your PC and its data out of the cloud and back on *silicona firma*. (Yes, I did just make that up.)

This guide will show you how to disable Windows 10's integration, as well as provide tips on what those features actually do. That way, you can decide whether you want to keep any of it active or just shut the door on it altogether.

Advertising

One setting you should consider disabling is all the advertising integration in Windows 10. Some of this was also present in Windows 8, but if you're just learning about it now you might as well turn it off.

Personally, I don't mind seeing ads on websites, because that's what pays for most of the free content we see online. What I do mind is "ad personalization." I don't need ads that are supposedly tailored to my personal tastes, thanks to little cookie spies that follow my travels around the web. Generic ads targeted at a site or app's most likely demographic are just fine by me, thanks.

Turning off personalized ads in Windows 10 is a two-step process. First, go to Settings ➔ Privacy ➔ General and slide the option that reads "Let apps use my advertising ID for experience across apps (turning this off will reset your ID)" to Off. (We'll come back to the Settings app later to deal with the rest of those privacy settings.)

Next, open your web browser and go to choice.microsoft.com/en-us/opt-out. There, select the Off position for "Personalized ads wherever I use my Microsoft account" and "Personalized ads in this browser."

> **Tip: If you're using an ad blocker or an extension like the EFF's Privacy Badger, you may have to turn it off for this site before you'll see the option to turn off in-browser ad personalization. The site apparently has to set a cookie for this second option to work.**
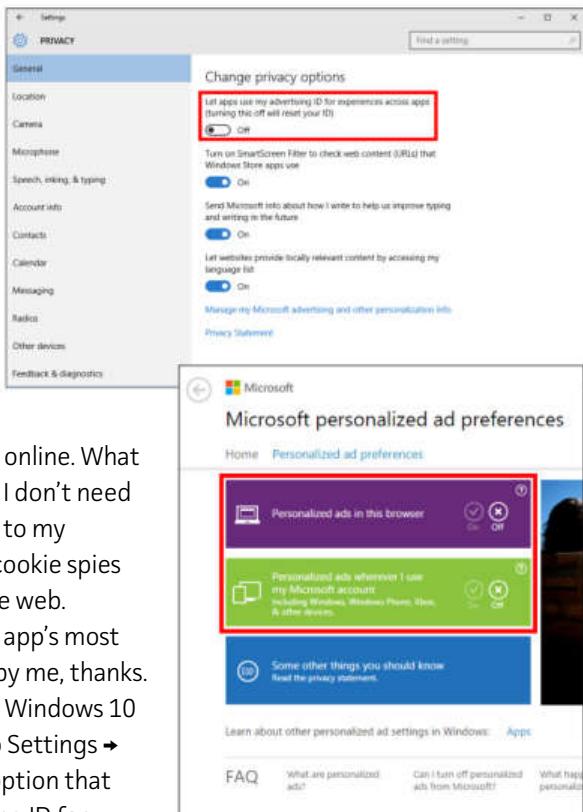
Cortana

Microsoft's built-in digital assistant is incredibly useful for quickly setting reminders, calendar events, and sending email, among many other things. The information it collects is very similar to what Google does with Google Now, which you may already be using on your Android device.

But if you're just not into Cortana, turning it off is very simple. And if you've never used Cortana, then don't worry about it! It's already off.

For everyone else, click the Cortana icon in the Taskbar, and then click the notebook icon on the left-hand side of the pop-up panel. Select Settings from the list of options that appear.

Now, just slide the top option that reads "Cortana can give you suggestions, ideas, reminders, alerts, and more" to Off.

Once Cortana is gone, you'll see a new option that says "Search online and include web results." As its title suggests, this includes Bing results (go.pcworld.com/disablebing) when you search for things on your PC. You'll have to decide whether you want that enabled.

At this time, it's also a good idea to jump back into the Settings app's privacy section. Open Settings and go to Privacy → Speech, Inking, And Typing. This is a setting that allows Cortana to gather all kinds of data about you to help it deliver services. Click the Stop Getting To Know Me button to end that. Note that this will delete collected data stored on your PC, and it also turns off dictation functionality.

Once that's done, click the "Go to Bing and manage personal info for all your devices" option. This is where you can scrub any data that Microsoft has collected about you from the company's servers.
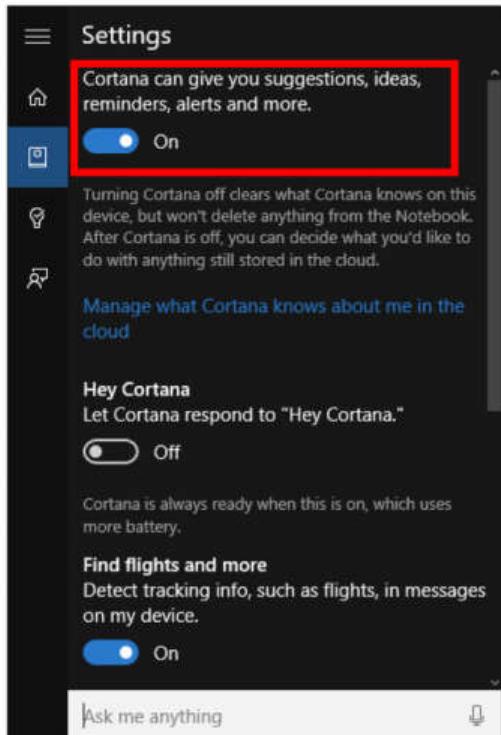
Clearing this data will affect the performance of Cortana and other personalization services across your devices and Microsoft services. You can read through this page to understand what you're losing, or just jump to the bottom and click Clear.

Wi-Fi Sense and peer-to-peer

Now let's handle two features of Windows 10 that are innovative, but also concerning to privacy-minded people.

The first is Wi-Fi Sense. This is turned on by default, but it doesn't do anything unless you explicitly use it. Wi-Fi Sense lets you share access to password-protected Wi-Fi routers. The passwords are shared silently in the background over encrypted connections. People with whom you share network access never see the actual passwords, and they cannot grant sharing permissions for their friends.

The idea is that if your friends or family come over to your house, they don't have to ask for your password. Instead, anyone who uses a Windows 10 device and is a digital friend of yours is automatically logged in. This is arguably more secure than sharing your password—once a person knows your Wi-Fi password they can easily share it with others, after all.

To make sure Wi-Fi Sense is off and stays off, go to Settings ➜ Network & Internet ➜ Wi-Fi ➜ Manage Wi-Fi Settings. Then slide the two options that say "Connect to suggested open hotspots" and "Connect to open networks shared by my contacts" to Off.

Moving on, Windows 10 shares system files and updates downloaded to your PC with others by default. This peer-to-peer networking feature turns you into what you might call an unwitting good Windows citizen by helping others get updates and system files faster.
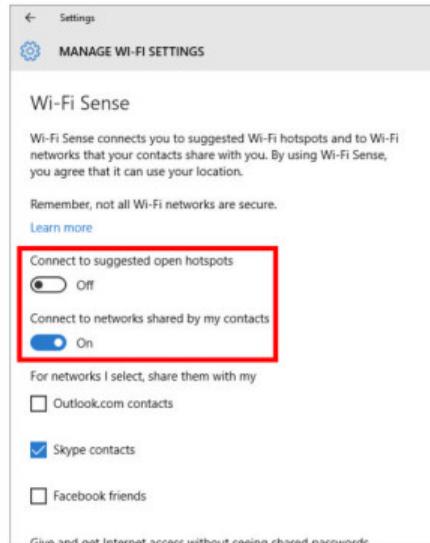
In return, your PC also receives update bits via other people's PCs. It's like using a BitTorrent client, essentially.

If you don't like the sound of that, go to Settings ➜ Update & Security ➜ Windows Update ➜ Advanced Options ➜ Choose How Updates Are Delivered. By default, the "Updates from more than one place" option is enabled and set to both local sources and other PCs on the Internet. You have two additional choices, however: You can distribute updates only to PCs on your local network, or shut off the P2P updates entirely and stick to using Microsoft's servers alone.

If you want to shut off everything, just turn the slider on this screen to Off. If you want to share with PCs on your local network, leave the slider in the On position and select the radio button that says "PCs on my local network." For more detailed instructions, check out our primer on stopping P2P Windows 10 updates (go.pcworld.com/w10updateno).

OneDrive

If you're not interested in storing your files on Microsoft's cloud servers, you can turn off OneDrive so it stops bugging you to configure it.

Just click the upward-facing arrow in the system tray on the right-hand side of the Taskbar. Then right-click the OneDrive icon and select Settings.

In the new window that opens, uncheck "Start OneDrive automatically when I sign in to Windows." You can also uncheck the other two boxes if they're selected as well: "Let me use OneDrive to fetch any of my files on this PC," and "Use Office to work on files with other people at the same time."
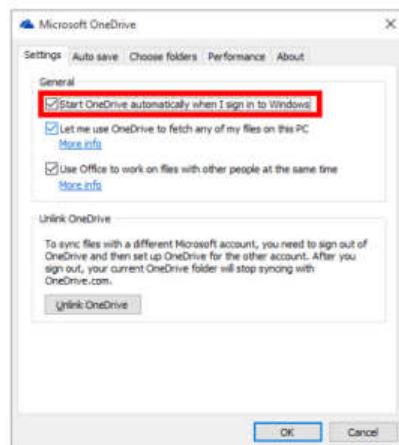
Back to Settings

Woo! Let's take a breather. Feeling good? We've got the most essential parts of our privacy lockdown finished. Ready for some
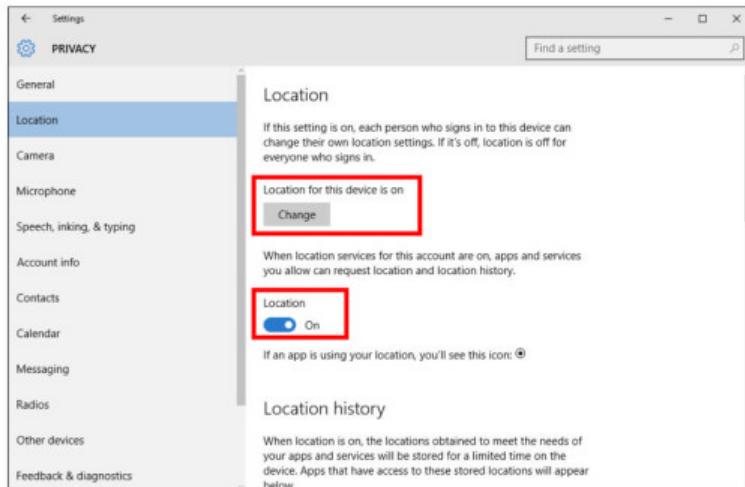
more? It's time to dive into all those other privacy options in the Settings app by going to Settings ➜ Privacy.

This is really the core of Windows 10's privacy controls, but most are not as critical as the other items we've covered. The exception would be the remaining items under Privacy ➜ General. Here you'll want to turn off "Send Microsoft info about how I write to help us improve typing and writing in the future." You may also want to shut off "Let websites provide locally relevant content by accessing my language list."

After taking care of the settings under General, what you'll mostly see in the remaining sections are methods for apps to access your data.

Each panel is pretty self-explanatory.

The Location section lets you control whether apps can use your location to deliver services like weather forecasts and local news. Location is a little unusual, because it can be set both on a per-device or per-user basis. To turn off location for the whole PC, click the Change button. To turn it off for only the logged-in user, turn the Location slider to Off.

You can also control location settings on a per-app basis by scrolling down to "Choose apps that can use your location."

After location is taken care of, the rest of the settings follow a similar

format, allowing you to turn off access to things like your camera, microphone, contacts, and calendar on a systemwide or per-app basis. Just be careful not to let your privacy zeal impact truly useful features. The Mail app has reasonable justification for accessing your contacts, for example.

Microsoft Edge

Even if you use Microsoft's fancy new browser, you may want to disable some features—like Cortana integration and typing prediction—if you don't want to send any data back to Microsoft.

Open Edge and click on the menu icon in the far right corner (three horizontal dots). Go to Settings → View Advanced Settings. Here you have the option to turn off Adobe Flash—stop those Flash cookies!— and under Privacy And Services you can decide to switch off a number of settings.

> "Offer To Save Passwords and Save Form Entries are both on by
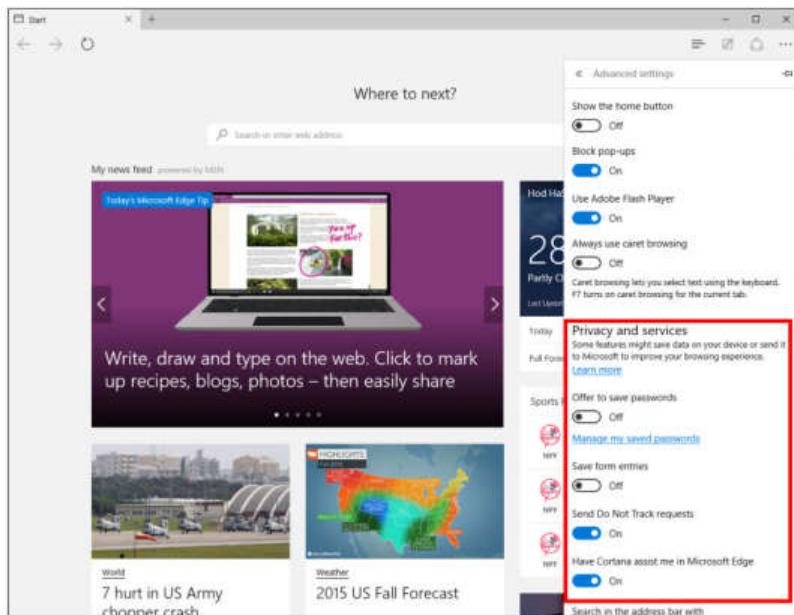
Microsoft Edge's Advanced options.

default. They are handy features though. Your call!

> "Have Cortana assist me in Microsoft Edge" lets Cortana work inside the browser. If you've already switched off Cortana, you definitely don't want this feature on.

> "Show search suggestions as I type" uses Microsoft's web-powered prediction service to guess what you're searching for and fill it in automatically. Chrome and the standard version of Google search offer something similar, so you may already appreciate this convenience elsewhere and not realize it.

> "Use page prediction to speed up browsing, improve reading, and make my overall experience better" is similar to search suggestions in that it sends your browsing history to Microsoft. The company says this feature "uses aggregated browsing history data to predict which pages you're likely to browse to next, and then loads those pages in the background for a faster browsing experience." If you don't like the sound of that, turn it off.

> If you use Microsoft Edge, you may want to disable some features if you don't want to send any data back to Microsoft.

> "Help protect me from malicious sites and downloads with SmartScreen filter" lets Microsoft block malicious sites and downloads from infecting your PC. This feature lets Microsoft download a list of bad-acting URLs to your PC so Edge can block those sites. With SmartScreen active, whenever you land on a malicious URL you will be redirected to a Microsoft webpage that will get some PC information and the URL of the page you visited. If you ask me, the SmartScreen filter is pretty benign and well worth keeping activated.

For more information, check out Microsoft's Edge privacy FAQ (go. pcworld.com/edgefaq).

Control Panel SmartScreen

There are three—count 'em, three—SmartScreen filters in Windows 10. The second one is in the Control Panel and stops you from installing potentially malicious desktop programs on your PC. It first

appeared in Windows 8.

To offer this security feature, however, you have to share with Microsoft anonymized information about the programs you download and install.

Advanced users may just want to disable this feature, as it tends to be a nuisance. I'd strongly advise novice and intermediate users to leave SmartScreen as-is, however.

To disable it, right-click the Start menu button and select Control Panel from the context menu. Then, with the category view enabled, navigate to System And Security → Security And Maintenance. Select Change Windows SmartScreen Settings from the left-side pane.

In the window that opens, select the radio button next to "Don't do anything (turn off Windows SmartScreen)."

Windows 10 and the web

Nope, we're still not done. Two more sections to go—although the last one is only for the hard-core privacy types. First we want to deal with some odds and ends.

Let's start by examining the way Windows 10 syncs your personalized settings across devices, including your desktop background, web browser settings, saved passwords, language preferences, ease of access, and so-called "other Windows settings."

The ability to sit down with any Windows 10 device, log in with your Microsoft account, and have all your settings and preferences immediately show up is powerfully handy indeed. But if you'd rather not store all that information in Microsoft's servers, the easiest thing to do here is just turn the Sync settings option found under Settings ➜ Accounts ➜ Sync Your Settings to Off. If you want to take a more fine-grain approach, you can drill down into the synced items under Individual Sync Settings.

> SmartScreen Filter checks the URLs of Windows Store apps to make sure they're not up to anything fishy.

Finally, let's move on to the SmartScreen Filter. No, not the Edge one. Nope, not the one for downloading apps either. This is the Windows Store version we saw previously under Settings ➜ Privacy ➜ General.

Like its Edge counterpart, SmartScreen Filter checks the URLs of Windows Store apps and makes sure they're not up to anything fishy. It's a security measure that I'd argue is worth turning on. But if you'd rather not use it, go to Settings ➜ Privacy ➜ General and slide the option that says "Turn on SmartScreen Filter to check web content (URLs) that Windows Store apps use" to Off.

Local account

Finally, we've come to the last step: using Windows 10 with a local account. This is basically like putting a Windows 7 user account on your PC, with few ties to the cloud.

Navigate to Settings ➜ Accounts ➜ *Your account name* and then select "Sign in with a local account instead." Then just follow the wizard to start using a local account on your PC—one that isn't tied to your Microsoft account.

Using a local account will still let you access some built-in features in Windows 10, such as the Mail app, but you may also lose access to

Switch to a local account

You can use an account on this PC only, instead of signing in with your Microsoft account. Save your work now, because you'll need to sign out to do this.

First, we need to verify your current password.

Ian Paul

Current password

others that require a Microsoft account, such as the Windows Store. You also can't sync your settings to other Windows devices, but if privacy is your focus you probably turned that off in the previous step anyway.

So there you have it: all the privacy steps you need to take to keep Windows 10 firmly planted on the desktop and not the cloud. It's admittedly a lot of work, but the good news is it only takes a few minutes to stay local once you know what you need to do.

But wait, there may be more?

This guide is only meant to turn off the user-facing cloud-connected facets of Windows 10. When this piece was being readied for publication, *Ars Techica*'s Peter Bright reported that there appears to be more "phoning home" going on behind the scenes with Windows 10—even with all the previous privacy steps completed.

For those who want to dig into the nuts and bolts of Windows 10 and its connection to Microsoft servers, we recommend you turn to *Ars Technica*'s report after you've taken the steps outlined here. Without taking these privacy measures first, dealing with what's left won't do much good. ⏻
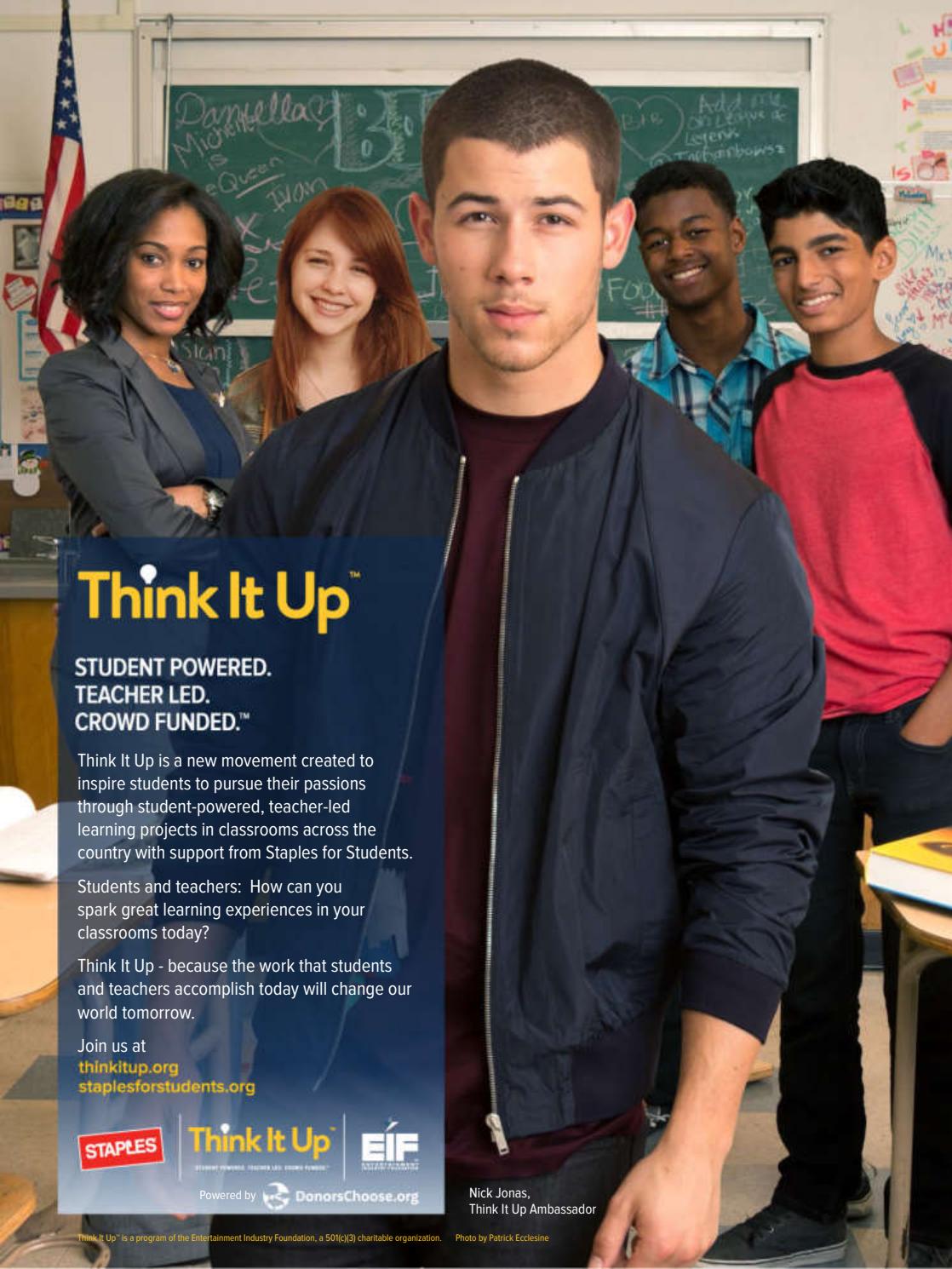
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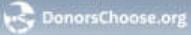
Nick Jonas,
Think It Up Ambassador

Most Android phones can be hacked with a simple MMS message

BY LUCIAN CONSTANTIN

THE VAST MAJORITY of Android phones can be hacked by sending them a specially crafted multimedia message (MMS), a security researcher has found.

The scary exploit, which only requires knowing the victim's phone number, was developed by Joshua Drake, vice president of platform research and exploitation at mobile security firm Zimperium.

Drake found multiple vulnerabilities in a core Android component called Stagefright that's used to process, play, and record multimedia files. Some of the flaws allow for remote code execution and can be triggered when receiving an MMS message, downloading a specially crafted video file through the browser or opening a webpage with embedded multimedia content.

There are many potential attack vectors because whenever the

Android OS receives media content from any source, it will run it through this framework, Drake said.

The library is not used just for media playback, but also to automatically generate thumbnails or to extract metadata from video and audio files such as length, height, width, frame rate, channels, and other similar information.

This means that users don't necessarily have to execute malicious multimedia files in order for the vulnerabilities found by Drake to be exploited. The mere copying of such files on the file system is enough.

The researcher isn't sure how many applications rely on Stagefright, but he believes that just about any app that handles media files on Android uses the component in one way or another.

The MMS attack vector is the scariest of all because it doesn't require any interaction from the user; the phone just needs to receive a malicious message.

For example, the attacker could send the malicious MMS when the

> The MMS attack vector is the scariest of all because it doesn't require any interaction from the user; the phone just needs to receive a malicious message.

victim is sleeping and the phone's ringer is silenced, Drake said. After exploitation the message can be deleted, so the victim will never even know that his phone was hacked, he said.

The researcher didn't just find the vulnerabilities, but actually created the necessary patches and shared them with Google in April and early May. The company took the issues very seriously and applied the patches to its internal Android code base within 48 hours, he said.

That code gets shared in advance with device manufacturers that are in the Android partnership program, before it's released publicly as part of the Android Open Source Project (AOSP).

Unfortunately, due to the generally slow pace of Android updates, over 95 percent of Android devices are still affected, Drake estimates.

Even among Google's Nexus line of devices, which typically get patches faster than those from other manufacturers, only the Nexus 6

has received some of the fixes so far, the researcher said.

Android patches can take months to reach end-user devices through over-the-air updates. That's because manufacturers have to first pull Google's code into their own repositories, build new firmware versions for each of their devices, do testing, and then work with mobile carriers to distribute the updates. Devices older than 18 months generally stop receiving updates entirely, leaving them vulnerable to newly discovered issues indefinitely.

The vulnerabilities found by Drake affect devices running Android versions 2.2 and higher, which means that there are a huge number of devices that will probably never receive patches for them.

The researcher estimates that only around 20 to 50 percent of the Android devices that are in use today will end up getting patches for the issues he found. He noted that 50 percent is wishful thinking and that he would be amazed if that happened.

In an emailed statement, Google thanked Drake for his contribution and confirmed that patches have been provided to partners.

"Most Android devices, including all newer devices, have multiple technologies that are designed to make exploitation more difficult," the company said. "Android devices also include an application sandbox designed to protect user data and other applications on the device."

What attackers can do after they exploit the vulnerabilities found by Drake can vary from device to device. Their malicious code will be executed with the privileges of the Stagefright framework, which on some devices are higher than on others. In general the attackers will get access to the microphone, camera, and the external storage partition, but won't be able to install applications or access their internal data.

That said, Drake estimates that on around 50 percent of the affected devices the framework runs with system privileges, making it easy to gain root access and therefore complete control of the device. On the rest of devices, attackers would need a separate privilege escalation vulnerability to gain full access.

Since the patches for these flaws are not yet in AOSP, device manufacturers that are not Google partners don't have access to them. It also means that third-party AOSP-based firmware like CyanogenMod is still likely vulnerable.

Drake shared the patches privately with some other affected parties, including Silent Circle and Mozilla.

Silent Circle included the fixes in version 1.1.7 of PrivatOS, the Android-based firmware it developed for its Blackphone privacy-focused device.

Mozilla Firefox for Android, Windows and Mac, as well as Firefox OS were affected by the flaws because they used a forked version of Stagefright. Mozilla fixed the issues in Firefox 38, released in May. ⏻

This nasty Android ransomware changes your phone's PIN code

BY JEREMY KIRK

RESEARCHERS AT SECURITY company ESET have found a type of malware that changes an Android device's PIN, the first of its kind in an ever-evolving landscape of ransomware attacks.

For most users, the only option to get rid of the malware is to reset

Update patch installation	Update patch installation	Update patch installation
Please, wait. Unpacking the components...	Click Activate button in the next window . Given operation can't be cancelled. Additional information you can find here: http://redtube.com	Installation is complete
Continue	Continue	Continue
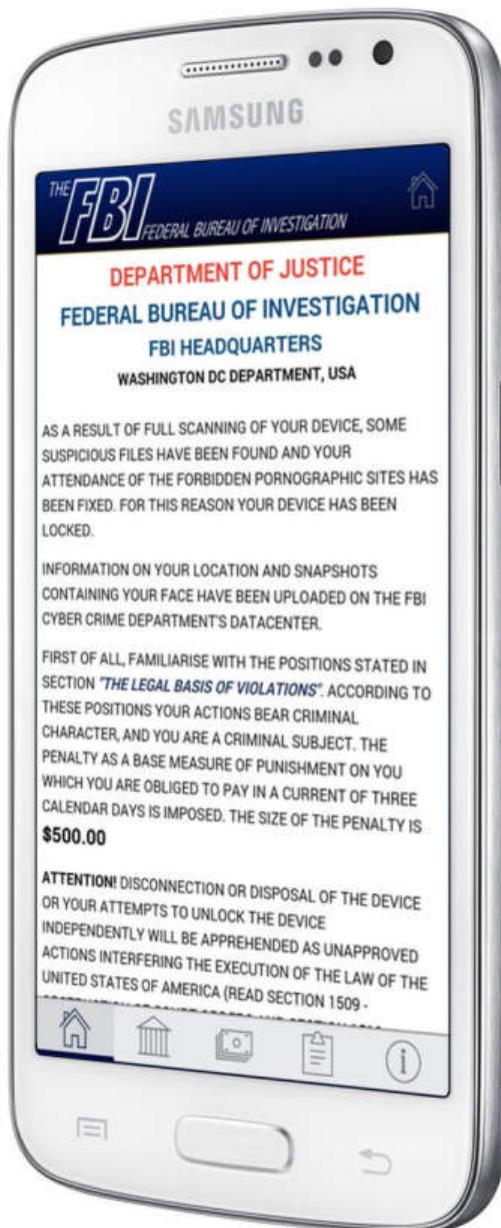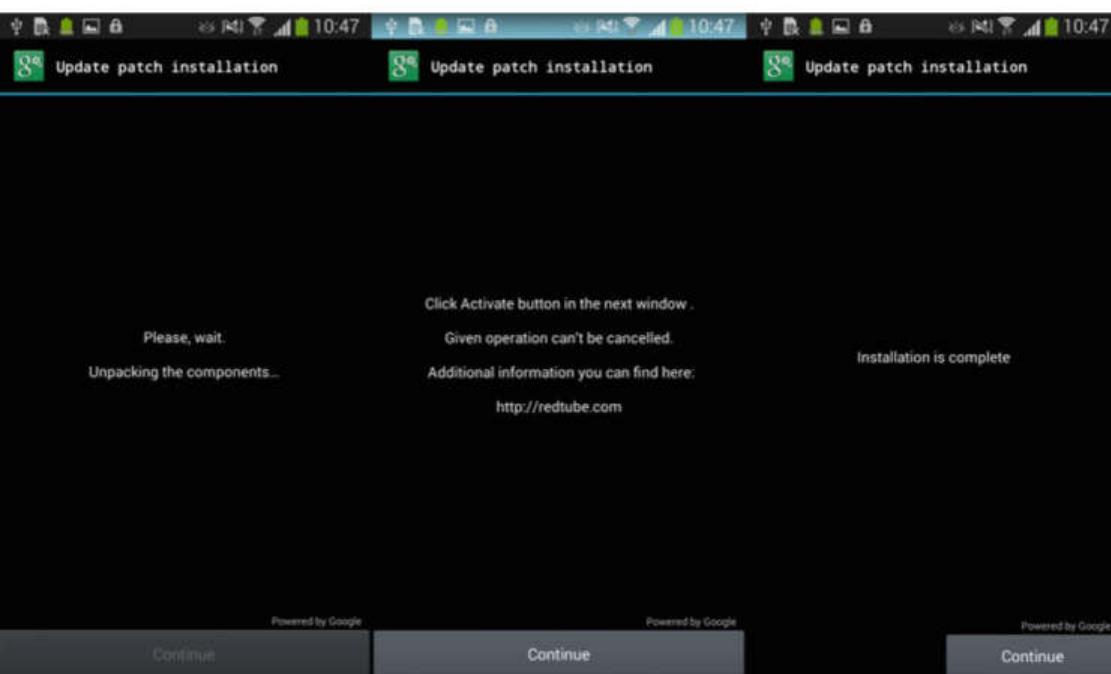
the phone to its factory settings, which unfortunately also deletes all the data on the device.

The malware calls itself "Porn Droid" and bills itself as a viewer for adult content. It has only been seen on third-party Android application marketplaces or forums for pirated software, wrote Lukas Stefanko, an ESET malware analyst.

But after it's installed, users see a warning supposedly from the FBI that they've allegedly viewed "prohibited pornography." It asks for a US$500 fine to be paid within three days.

To change the device's PIN, Porn Droid needs administrator-level access to the phone. Stefanko wrote that the malware uses a new method to obtain that high level of access.

When Porn Droid runs, it asks people to click a button to activate the viewer app. But beneath that window, and obscured by it, is another

Porn Droid tricks a user into granting admin access through deceptive windows.

button for setting device administer privileges.

"After clicking on the button, the user's device is doomed," Stefanko wrote. "The Trojan app has obtained administrator rights and now can lock the device. And even worse, it sets a new PIN for the lock screen."

Other kinds of Android malware locked the screen by keeping the ransomware warning in the foreground using an infinite loop.

> Other kinds of Android malware locked the screen by keeping the ransomware warning in the foreground using an infinite loop.

But that could be remedied by using a command-line tool, the Android debug bridge (go.pcworld.com/androiddebug), or deactivating admin rights in Safe Mode (go.pcworld.com/androidsafemode), according to Stefanko.

In the case of Porn Droid, if someone tries to deactivate the admin privileges, the malware uses a call-back function to reactivate them, Stefanko wrote.

The malware is also coded to try to shut down three mobile antivirus products: Dr. Web, ESET's Mobile Security, and Avast.

More advanced users may be able to get rid of Porn Droid without resetting and erasing all data on their phone. It is possible to remove the malware if a user has root privileges to the device, and some security software can stop it, Stefanko wrote.

Ransomware attacks, both desktop and mobile, have become some of the most persistent and damaging scams on the Internet. One of the most prevalent scams is encrypting a person's files and asking for money for the files to be decrypted.

Security experts generally advise not paying the ransom, as in many cases fraudsters never bother to fix the victim's computer. ⏻

"SURE, AT FIRST I WAS A LITTLE TAKEN ABACK BY THE WHOLE PEEING STANDING UP THING. BUT I TAUGHT HIM TO THROW A STICK AND NOW HANGING OUT WITH HIM IS THE BEST PART OF MY DAY."

—EINSTEIN
adopted 12-09-10

A PERSON IS THE BEST THING TO HAPPEN TO A SHELTER PET

adopt

theshelterpetproject.org

Don't use waterproof Xperia phones underwater, Sony says

BY IAN PAUL

SONY MOBILE IS changing its stance over its waterproof phones. Apparently, when the company says Xperia phones are waterproof, it just means that if you try to use them underwater you'll end up with proof that H2O can destroy your phone. Well, not quite—but Sony's got a lot of explaining to do.

The company was not available for comment at the time of this writing.

The waterproof explanation page (go.pcworld.com/xperian-h20proof) for Sony Mobile Xperia phones now includes the following disclaimer, "Remember not to use the device underwater," as first noted by Xperia Blog (go.pcworld.com/xperianblog). That's a surprising turnaround considering the company has advertised Xperia waterproof phones with images of people using their phones underwater.

Xperia waterproof phones typically have an IP65/68 rating, which means they are completely resistant to dust, can resist low-pressure water jet spray for at least 3 minutes, and can remain functional after immersion below a minimum 1 meter (3.28 feet) depth.

Snap away with a waterproof smartphone

With the waterproof Xperia Z3v, you can take pictures with the best smartphone camera while swimming in fresh water for up to 30 minutes. You can even dive down to 5 feet with it. Just remember that all the covers for the micro USB port, the micro SIM slot and the memory card slot must be firmly closed.

So can I take it underwater or not, Sony?

The problem seems to be that when Sony tested each device to achieve its IP rating the test wasn't exactly rigorous. "Sony devices that are tested for their waterproof abilities are placed gently inside a container filled with tap water and lowered to a depth of 1.5 meters," Sony's waterproof page says. "After 30 minutes in the container, the device is gently taken out and its functions and features are tested."

In practical terms this means Xperia waterproof phones can stand up to a heavy rainstorm, a non-water immersing web browsing session in the bath, or a run under the bathroom faucet. But all those shots of fun-loving people taking videos in lakes and chlorine-laden swimming pools? That's pushing it.

At least according to some pages. As Xperia Blog points out, other parts of Sony Mobile's site still encourage you to dive underwater with your device.

For the most part, however, Sony warns you on the limits of its non-waterproof waterproof phones. Case in point is the company's Xperia M4 Aqua (go.pcworld.com/m4aqua). Dubbed the "waterproof camera phone for everyone" it has this under the fine print: "You should not put the device completely underwater or expose it to seawater, salt water, chlorinated water, or liquids such as drinks. Abuse and/or improper use of the device will invalidate warranty."

The impact on you at home: If you have an Xperia waterproof phone you should heed Sony's warning even if you've taken underwater shots with your phone in the past. Should it get damaged during such an excursion, Sony could refuse to help and point to its support materials that warn against taking them into the water. Sure, it has tons of marketing materials encouraging the opposite, but those images aren't to be taken literally, it seems. ⏻

How many light bulbs does it take to change an American?

It's no joke: climate change is a critical issue for all life on Earth. But can the actions of one individual really make a difference? Visit nature.org to calculate your impact on the world around you and learn about steps you can take to make the world a better place for us all.

nature.org/calculate

The Nature Conservancy

Protecting nature. Preserving life.™

REVIEWS & RATINGS

CONTENTS

The best web browser of 2015: Firefox, Chrome, Edge, IE, and Opera compared

We've tested the top browsers—Google Chrome, Microsoft's Edge and Internet Explorer, Mozilla Firefox, and Opera—against a variety of simulated and real-world tests, and picked a winner.

BY MARK HACHMAN

THE BEST BROWSERS go beyond benchmarks, racing through real-world webpages as well as canned routines. They're easy to set up, flexible and extensible, and connect other devices and services into an ecosystem.

Look, throwing a few benchmarks at a browser just doesn't cut it any more. Just as you expect us to test graphics cards against the latest games, we think your browsers should be tested against a collection of live sites. Can they handle dozens of tabs at once? Or do they shudder, struggle, and crash, chewing through your PC's processor and memory?

To pick a winner, we put Google Chrome, Microsoft's Edge and Internet Explorer, Mozilla Firefox, and Opera to the test, barring Apple's abandoned Safari for Windows. We used the latest available version of each browser, except for Firefox, which upgraded to Firefox 40 late in our testing. And we also tried to look at each browser holistically: How easy was each to install and set up? Does Opera make it simple to switch from Chrome, for example?

Our tests have shown that enabling Adobe Flash can have much of an impact on your system. Disabling or refusing to load Flash can seriously improve performance—some sites, like YouTube, have begun to transition to less CPU-intensive HTML5 streams. Still, other readers

For 2015, we have a newcomer: Microsoft's Edge browser, which has been integrated into Windows 10.

	HTMLTEST	WEBXPRT 2015 V. 1.998	SPEEDOMETER 1.0	JET STREAM 1.1	SUNSPIDER 1.0.2 (LOWER IS BETTER)
Opera 31.0 .1889.99	525	323	66.62	171.25	230.73
Internet Explorer 11	548	267	36.23	124.82	94.57
Firefox 39	467	384	56.76	164.73	185.6
Edge 12.10240	402	330	29.74	178.75	101.13
Chrome 44.0.2403	526	325	84.07	174.58	226.67
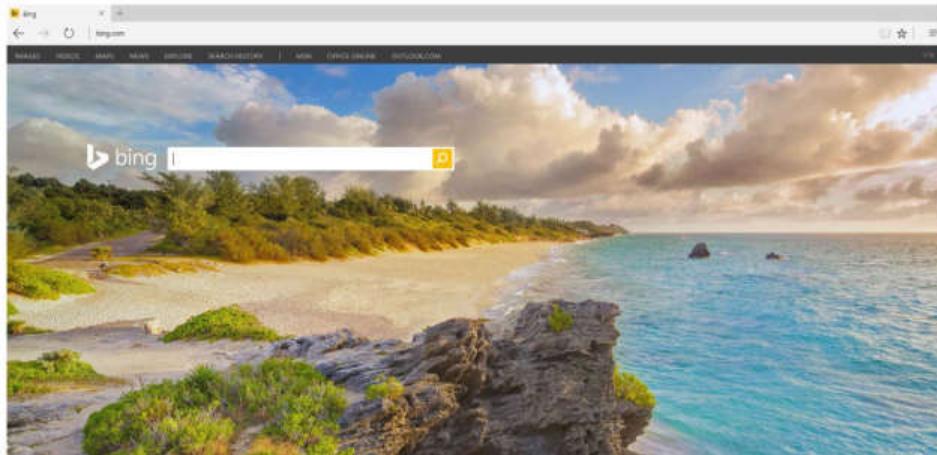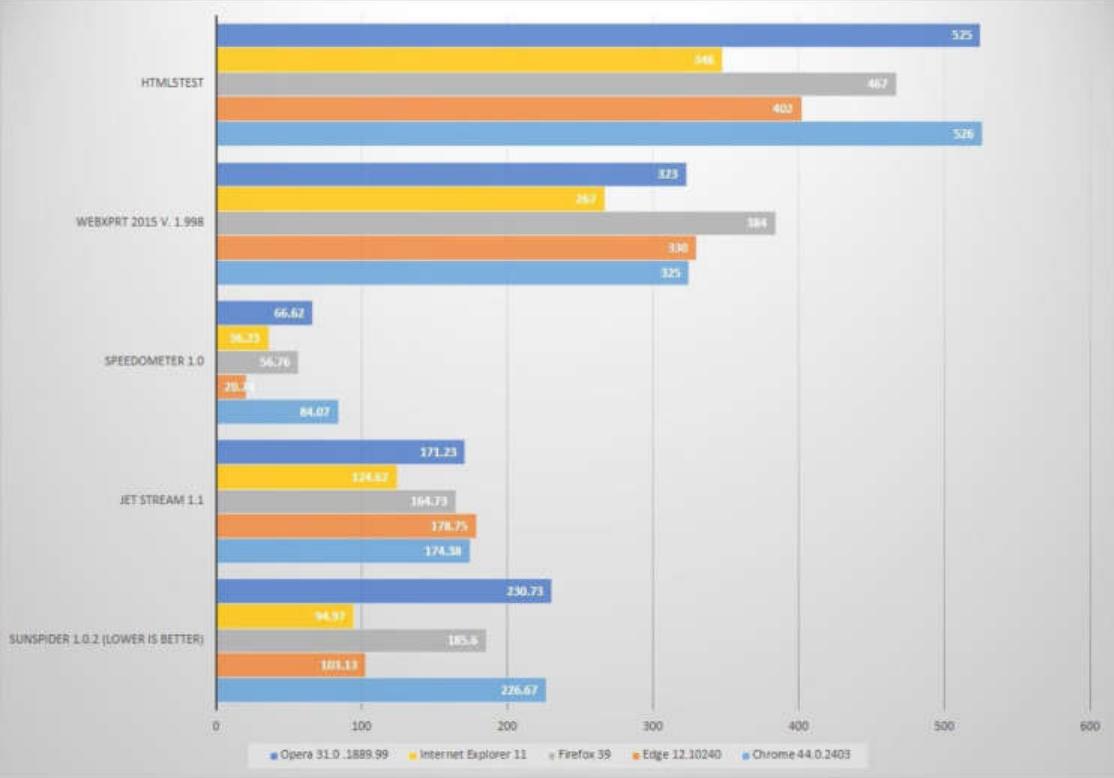
pointed out that they simply need to run Flash on their favorite sites. That's fine—we tested with and without Flash, so you'll have a sense for which browser performs best, in either case.

Oh, and Microsoft: We found that your new Edge browser isn't *quite* as fast as you make it out to be. (Sorry!) But it still demonstrated definite improvement over Internet Explorer.

The benchmark numbers favor Chrome and Firefox

We do consider benchmarks to be a valuable indicator of performance,

Google Chrome and Mozilla Firefox do well here. (A higher result is better, except for the Sunspider benchmark.)

just not a wholly defining one. Still, they're the numbers that users want to see, so we'll oblige. We used a Lenovo Yoga 12 notebook with a 2.6GHz Intel Core i7-5600U inside, running a 64-bit copy of Windows 10 Pro on 8GB of memory as our test bed.

We tested Chrome 44, Windows 10's Edge 12, Firefox 39, Internet Explorer 11, and Opera 31 against two popular (though unsupported) benchmarks—Sunspider 1.0.2 and Peacekeeper—just for reference purposes. But we'd encourage you to pay attention to the more modern benchmarks, including Jet Stream, Octane 2.0, Speedometer (go.pcworld.com/speedometer), and WebXPRT. The latter two are especially useful, as they try to mirror actual interaction with web apps. We also tested using Oort Online's graphics benchmark as well as

Benchmark	Opera 31.0 .1889.99	Internet Explorer 11	Firefox 39	Edge 12.10240	Chrome 44.0.2403
OCTANE 2.0 (GOOGLE)	26247	15637	28138	29442	30194
PEACEKEEPER (UNSUPPORTED)	4501	2864	5244	2957	4620
OORT ONLINE 0.2.2	6610	0	3617	5653	6387

■ Opera 31.0 .1889.99　■ Internet Explorer 11　■ Firefox 39　■ Edge 12.10240　■ Chrome 44.0.2403

Page load time (seconds)

Browser	Time
OPERA 31.0 .1889.99 (WITH FLASH)	2.22
OPERA 31.0 .1889.99	1.64
INTERNET EXPLORER 11 (W/FLASH)	3.89
INTERNET EXPLORER 11	2.35
FIREFOX 39 (W/FLASH)	5.69
FIREFOX 39	2.6
EDGE 12.10240 (W/FLASH)	4.24
EDGE 12.10240	3.26
CHROME 44.0.2403 (W/FLASH)	2.33
CHROME 44.0.2403	1.8

the standardized HTML5test—which is not so much a benchmark, but an evaluation of how compatible a browser is with the HTML5 standard for Web development.

From our testing, Chrome and Firefox topped the Speedometer and WebXPRT tests, respectively. Perhaps unsurprisingly, Google was the fastest browser under the Google-authored Octane 2.0 benchmark. But Microsoft's Edge led the pack in the Jet Stream benchmark— which includes the Sunspider tests, which Edge led as well. (For all of the benchmarks, a higher number is better; the one exception is Sunspider, which records its score in the time it took to run.)

What's surprising about Edge is that it led the pack in the Jet Stream benchmark, but fell way behind on Speedometer, only to record a quite reasonable score in WebXPRT. (Microsoft claims that Edge is

faster than Chrome in the Google-authored Octane 2.0 benchmark as well, but our results don't indicate that.)

Chrome flopped on the Sunspider test; the only test Firefox failed equally miserably in was the Oort Online benchmark, which draws a *Minecraft*-like landscape using the browser.

For whatever reason, I noticed some graphical glitches as Edge rendered the Oort landscape, including problems drawing a shadow that slid across the bay in the night scene. But Oort proved even more problematic for Firefox, rendering "snow" as flashing lights and rain as a series of lines. (We've included the test result, but take it with a grain of salt.) Internet Explorer 11 simply couldn't run the Oort benchmark at all.

We also included the HTML5test compatibility test, which measures how compatible each browser is with the latest HTML5 Web standards. Although some developers focus extensively on each browser's score, even the test developer isn't too concerned:

HTML5test scores are less interesting to me than people think. Any browser above 400 points is a perfectly fine choice for todays web.
                    — HTML5test (@html5test) August 2, 2015.

And the only one that fails that test, of course, is the semi-retired Internet Explorer 11.

What does all this mean? It doesn't indicate a clear win for any specific browser, including Chrome. Based on our benchmark tests, many of the browsers will handle the modern web just fine.

Real-world testing: Opera makes its case

Opera Software has always lived on the periphery, with what NetApplications (netmarketshare.com) says is just 1.34 percent of the worldwide browser market. With Opera considering putting itself up for sale (go.pcworld.com/operaforsale), it may not be long for this world. But in terms of real-world browser performance, Opera is worth a long hard look while you still can.

Why? Because in real-world browser tests, Chrome and Opera

performed very well.

It's important to know how each browser will actually perform while surfing the live web. Testing this is a challenge—some canny Web sites constantly tweak their content, and ads will vary from one visit to the next. But we tried to minimize the time over which we visited each site to help minimize variation.

We used a selection of 30 live sites, from Amazon to CNN to iMore to PCWorld, as well as a three-tab subset of each, to see how performance scaled. Our tests included adding each site to a new tab, one after another, to weakly approximate how a user might keep adding new tabs—but quickly, so as to stress-test the browser itself. Finally, we evaluated them with Adobe Flash turned on and off. (Both Opera and Firefox don't natively ship with Flash, so we tested without, then downloaded the Flash plugin.)

After loading all 30 tabs, we waited 30 seconds, then totaled the total CPU and memory consumption of both the app itself, the background processes, and the separate Flash process, if applicable.

So what does all this mean? If you own a mid-range and low-end PC, you might have purchased one without a lot of memory, or with a less powerful CPU. In that case, you might consider switching your browser to something that's more efficient.

This chart contains a lot of information; you can click it to enlarge it. But what you should focus on are the differences in memory consumption (the yellow bars) and the differences in CPU consumption. We've included the raw data in a table at the bottom of the chart. In each case, a lower number indicates a more efficient
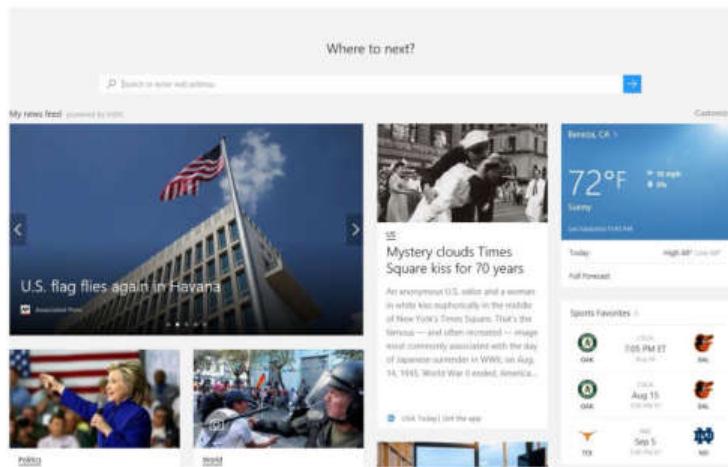
You can configure the Microsoft Edge homepage to show you information that allows you to start your day. (iGoogle did this too, years ago.)
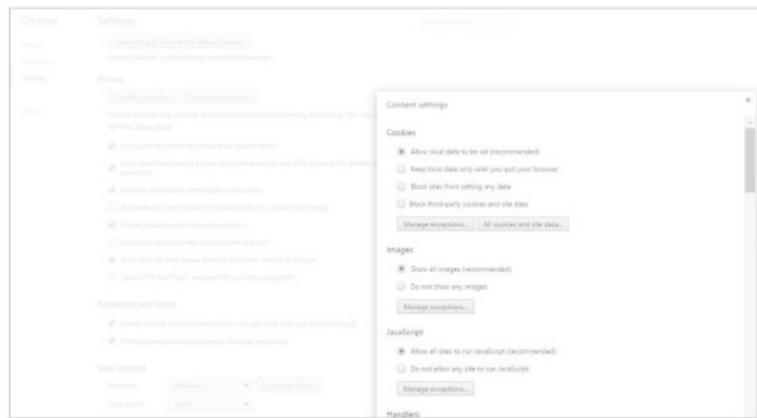
browser, with the one exception being Firefox (with Flash)'s zero scores, which we'll cover in the chart.

Oddly enough, we noted an actual *decrease* in CPU consumption when Flash was enabled on the three-tab test, specifically within Edge, Firefox, and Opera—perhaps because the Flash plugin was more efficient at lighter workloads. As our previous report indicated, however, CPU and memory consumption soared when we started throwing tab after tab at each browser.

The other discrepancy that you may note is that Chrome, with Flash enabled, consumes nearly the memory that Edge does *without* Flash enabled. We double-checked this, but we did so on another day, where Edge's memory consumption was even higher than what we recorded. (That's probably due to just a difference in the ads and video the sites displayed.)

Chrome has a reputation for sucking up all the memory you can throw at it, and these numbers prove that out. But it also consumes relatively little of your CPU—which, if you scale down your tab use, makes its impact on your PC manageable. Opera, however, really shines. In fact, without Flash, Opera consumed just 6.6 percent of the CPU and 1.83GB of RAM during our stress test. With Flash on, Opera consumed 3.47GB of memory and 81.2 percent of my computer's CPU.

And Mozilla was getting on so well—but with Flash on, tabs essentially descended into suspended animation until they were clicked on, then began slowly loading. It was awful. "Tombstoning" tabs that aren't being used is acceptable, but please, load them first, Mozilla!

Finally, we tried loading pages, then timing how fast before the page became "navigable"—in other words, how soon one could scroll down. Fortunately, all the browsers we tested did well, although some were faster than others; Chrome and Opera did exceedingly well, especially with Flash turned off. In all, however, we'd say that any browser that can load pages at three seconds or less will suit your needs. (Keep in mind that the time to load pages depends in part on your Internet connection and the content of the page itself.)

Many browsers, including Opera, now allow you to sync your information across multiple devices.

The convenience factor

Since all of these browsers are free, ideally you should be able to download every one and evaluate it for yourself. And each browser makes it quite easy to pluck bookmarks and settings from their rivals, especially from Chrome and Internet Explorer. But manually *exporting* bookmarks is another story. It's almost like telling the browser that you're fed up with it—and Firefox, for example, passive-aggressively buries the export bookmarks command a few menus deep. Even stranger, Opera claims that you can export bookmarks from its Settings menu, but only the *import* option appears to have remained in Opera 31.

More and more, however, browsers are using a single sign-on password to identify you, store your bookmarks online, and make shifting from PC to PC a snap—provided that you keep the same browser, of course.

Chrome, for example, makes setting itself up on a new PC literally as simple as downloading the browser, installing it, and entering your username and password. You may have to double-check that the bookmark bar is enabled, for example, but after that your bookmarks and stored passwords will load automatically. (As always, make sure that "master" passwords like these are complex.)

Chrome isn't alone in this, either. Firefox's Sync syncs your tabs, bookmarks, preferences and passwords, while Opera syncs your bookmarks, tabs, the "Speed Dial" homepage, and preferences and settings.

That's an area where Edge needs improvement. Edge can import favorites/bookmarks from other browsers, manually, but doesn't keep a persistent list of favorites across machines—at least not yet. But if you save a new favorite in IE11, it's instantly available across your other PCs. Other browsers—not Edge—also allow you to access your desktop bookmarks within their corresponding mobile apps.

It's also interesting that, more and more, browsers are moving away from the concept of a "homepage" in favor of something like Edge or Opera, where the browser opens to an index page, with news and information curated by the browser company itself. But you still have
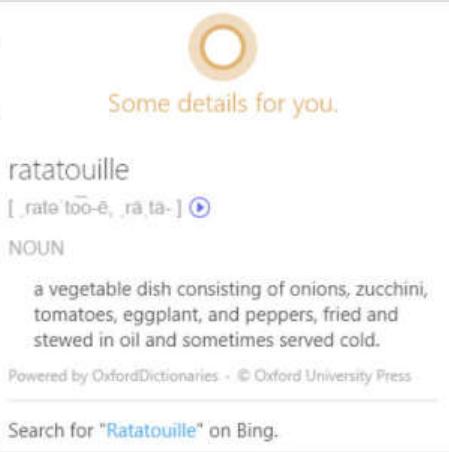
Right-click a term, and Microsoft Edge's Cortana swoops in to assist.

options to set your own homepage in Chrome, Edge, and Firefox.

Honestly, all of the browsers we tested were relatively easy to set up and install, with features to import bookmarks and settings either from other browsers or other installations. You may have your own preferences, but it's a relative dead heat.

Going beyond the web

Modern browsers, however, go beyond merely surfing the web. Most come with a number of intangible benefits that you might not know about.

Perhaps you'd like your browser to serve as a BitTorrent client, for example. In the early days, you'd need to download a separate, specific program for that. Today, those capabilities can be added via plugins or addons—which most browsers offer, but not Edge, yet. (This can be more than a convenience; Edge will store your passwords, but not in an encrypted password manager like LastPass.)

If there's one reason to use Firefox, it's because of the plugin capability. Mozilla has a site entirely dedicated to plugins (addons. mozilla.org), and they're organized by type and popularity. Installing a plugin is as easy as clicking through a couple of notifications, then restarting your browser. And given the market share of Chrome—and the plugin popularity of Firefox—you'll find developers who will focus on those two first. A good example is OneTab (one-tab.com), which transforms all of your open tabs into a text-based list, dramatically cutting your browser's memory consumption. Note that the more plugins you add and enable, the more memory and CPU power your browser will consume.

Opera doesn't appear to have nearly the number of available plugins (addons.opera.com) that Firefox does, but it does have a unique twist: a "sidebar" along the left hand side that can be used for widgets, like a calculator or even your Twitter feed. Opera is also extensible via wallpaper-like themes, but they're far less impressive.

But you'll also notice browsers adding more and more functionality right in the app itself. Firefox includes a Firefox-to-Firefox videoconferencing

service called Firefox Hello that works right in your browser, and you can save webpages to a Pocket service for later reading. And this is where Edge shines—its digital assistant, Cortana, is built right in, and there are Reading View options and a service to mark up webpages, called Web Notes. Cortana does an excellent job supplying context, and it's certainly one of the reasons to give Edge a try.

Over time, we expect that this will be one area where Edge and Chrome will attempt to "pull away," as it were. In a way, it's similar to the race in office suites: a number of apps mimic functionality that Microsoft Office had a few years ago. But Microsoft has begun building intelligence into Office, and Edge, elevating them over their competition. Given that Chrome is also the front door to Google Now on the PC, we may eventually see Google try to out-Cortana Cortana on her home turf.

Chrome narrowly beats Opera

So who wins? Here's the way we see it.

Give credit where credit is due: Edge's performance has improved to the point that it's competitive, though perhaps not as much as Microsoft would make it seem. Still, its lack of extensibility and proper syncing drag it down, at least until they're added later this year. Firefox also performed admirably, until it bogged down under our real-world stress test. We also believe Opera would be a terrific choice for you, since it zips through benchmarks and real-world tests alike. Sure, it lacks the tight OS and service integration of Chrome, IE, and Edge— but some may see that as a bonus, too.

All that said, we still think Google's Chrome is the best of the bunch.

Chrome has a well-deserved reputation for glomming on to and gobbling up any available memory, and our benchmarks prove it. But it's stable, extensible, performs well, integrates into other services, and reveals its depths and complexity only if you actively seek it out. For that reason, Google Chrome remains our browser of choice, with Opera just behind. ⏻

Tested: How Flash destroys your browser's performance

We tested the effects of browsing with and without Flash on several major browsers. Enabling Flash is, in a word, catastrophic.

BY MARK HACHMAN

Last month, the axe seemingly came down on Adobe Flash: three undiscovered vulnerabilities in Flash were leaked (go.pcworld.com/flashleaked) and exploited (go.pcworld.com/flashexploited). In

response, Mozilla's Firefox blocked Flash by default (go.pcworld.com/ffblockedflash) until Adobe issued a patch. You should know by now that installing Flash equals a security risk. But are you aware of how badly your PC can slow down as well?

Try *80 percent*.

As part of our roundup of the major browsers, we tested their abilities to handle Flash. Two browsers, Mozilla Firefox and Opera, do not include Flash, although you can download a plugin from Adobe to enable it. A third, Microsoft's new Edge browser, enables Flash by default, although you can manually turn it off. Both Internet Explorer 11 and Google's Chrome also include Flash, which you can disable or adjust within the Settings menu.

Adobe Flash is one of those legacy applications that just doesn't seem to go away. There's seemingly no real reason to install it—until you run into a blank spot on a page that asks you to install or update the Flash plugin. So you sigh, download (or enable) the plugin, and go back to browsing. Removing Flash and another PC security risk, Java, can be done—but it takes some effort. And most of us just aren't inclined to do so.

The Web's information superhighway is increasingly littered with ads, popups and worse.
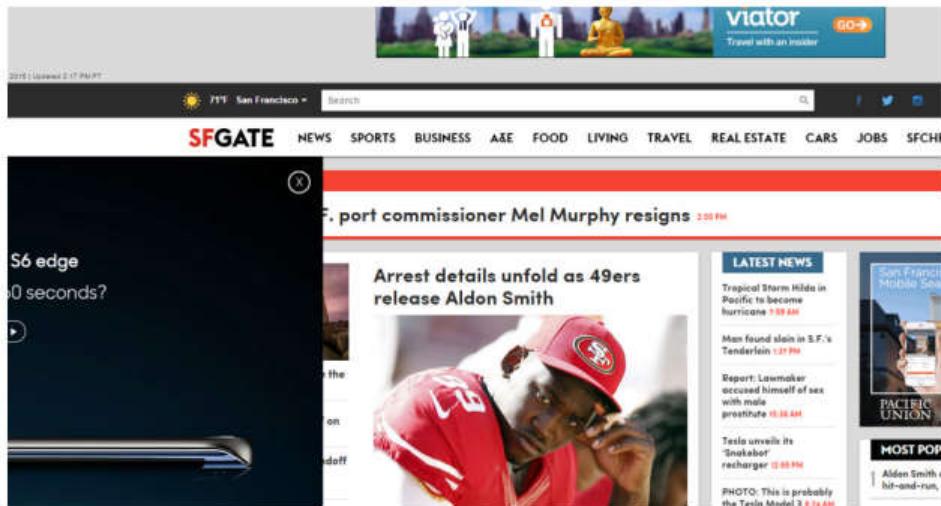
Testing in the real world

Let's start from the totally naive premise that Flash does *not* represent a security risk. Vulnerabilities occur in the background, surreptitiously lifting your data, installing rootkits, and the like. But they don't impact your day-to-day browsing, right? Maybe not. But simply using a browser with Flash installed can have major consequences on performance.

As we did in our Windows 10 review, we used a test bed of 30 live sites, ranging from Amazon to *The New York Times* to iMore to PCMag. com. Most of them have all sorts of embedded ads and trackers, which the sites use to track you, create a profile, and sell you stuff. Since they are live, there's always a possibility that ads and content can change from one visit to the next, but we were able to do our live testing over the course of a single day to try and minimize this.

We tested Chrome 44, Windows 10's Edge 12, Firefox 39, Internet Explorer 11, and Opera 31—all the latest versions at press time. We ignored Apple's Safari browser—sorry, Apple. For Firefox and Opera, we ran our tests without Flash installed, then downloaded the plugin from Adobe's site. With Edge, we toggled Flash on and off, using its

igfxHK Module	0%	1.3 MB	0 MB/s	0 Mbps
igfxTray	0%	1.8 MB	0 MB/s	0 Mbps
Integrated Camera Preview Rot...	0%	1.8 MB	0 MB/s	0 Mbps
Lenovo Power Management Ser...	0%	0.3 MB	0 MB/s	0 Mbps
Microsoft Edge	1.6%	194.2 MB	0 MB/s	0 Mbps
Microsoft Edge	0.3%	274.3 MB	0 MB/s	0 Mbps
Microsoft Edge	0.2%	175.9 MB	0 MB/s	0 Mbps
Microsoft Edge	0.8%	214.3 MB	0.1 MB/s	0.1 Mbps
Microsoft Edge	10.4%	573.3 MB	0.1 MB/s	0.2 Mbps
Microsoft Edge	1.3%	267.3 MB	0.1 MB/s	0 Mbps
Microsoft Edge	1.2%	324.3 MB	0 MB/s	0 Mbps
Microsoft Edge	4.3%	337.9 MB	0 MB/s	0.1 Mbps
Microsoft Edge	0%	40.0 MB	0 MB/s	0 Mbps
Microsoft Edge	2.1%	398.0 MB	0.1 MB/s	0 Mbps
Microsoft Edge Content Process	1.9%	262.8 MB	0 MB/s	0 Mbps
Microsoft Edge Content Process	0.2%	283.1 MB	0 MB/s	0 Mbps
Microsoft Edge Content Process	0.3%	169.2 MB	0 MB/s	0 Mbps

You can dig into the Task Manager (WIN + X) to find out what's chewing up your system resources. All these background processes slow your PC down.

Memory ■ CPU %

Microsoft Edge 12.10240 / Opera 31.0

	Without Flash	With Flash	Without Flash	With Flash
Memory	4180.9	4719.3	1832.8	3470.4
CPU %	32.6	84.1	6.6	81.2
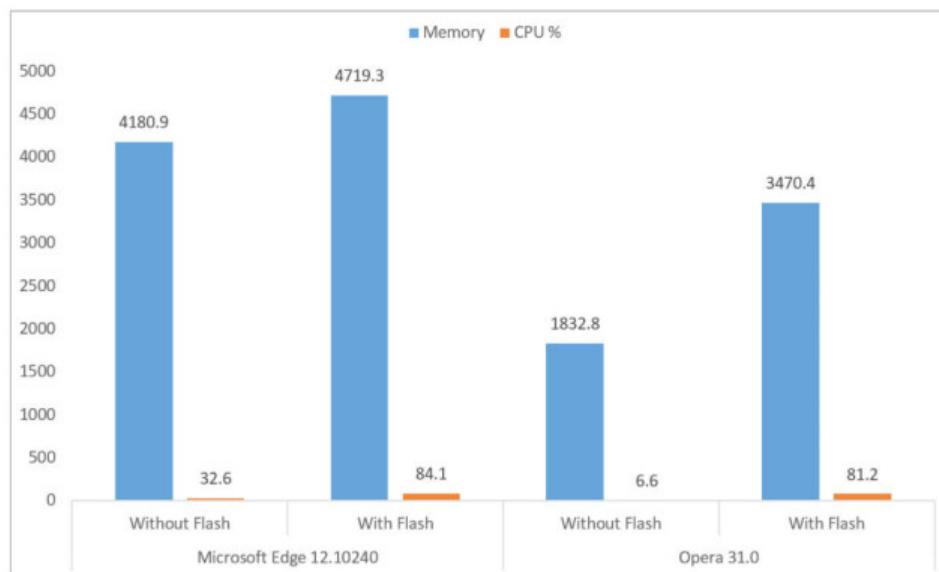
built-in control. We used a Lenovo Yoga 12 notebook with a 2.6-GHz Intel Core i7-5600U inside, running a 64-bit copy of Windows 10 Pro on 8 GB of memory.

Measuring the impact on your PCs CPU and RAM is somewhat subjective. Loading a page can take as little as a few seconds, for a text-heavy page with few embedded elements. Pages with embedded video, pre-roll advertising, and the like, can take over a minute. We tried to split the difference.

From our list of links, we cut and pasted each link into a new tab, weakly approximating how a user would add one tab, then another. But we did it quickly, to try and stress the browser by throwing a number of elements at it, all at once. After loading all 30 sites, we then waited 30 seconds for things to settle down, before opening Windows 10's Task Manager and recording the CPU load and memory consumption of both the apps as well as the background processes. If applicable, we added Flash's CPU and memory load as well. (We snapped a picture of the screen, then copied the values in by hand—a browser like Chrome, for example, has a ton of

Simply turning on and off Flash can make a significant difference in the amount of resources your browser uses.

background processes, all dynamically changing by the second.)

It's important to note that, especially with a midrange PC, that the amount of CPU cycles an app chews through will probably be what causes your PC to stutter and pause—and that's going to be what frustrates you most.

OMG, Flash

What we found was shocking.

We condemned Microsoft Edge, for example, for locking up in previous iterations of our 30-tab stress test. With Flash enabled, Edge survived—a testament, perhaps, to a massive bloc of updated code that Microsoft recently released. With Flash enabled, Edge chewed through 4.72 GB of memory, sucking down 84.1 percent of my PC's CPU cycles. With just Word Mobile open, that left my system functional.

But when I toggled Flash off, the same tabs required 4.12 GB of memory, and just 24.5 percent of my CPU. That's an 11 percent drop in memory consumed, and a whopping 61 percent decrease in CPU consumption.

And it just got better from there. Opera really surprised me with how efficiently it performed, consuming just 3.47 GB of memory with Flash enabled—the lowest of all the browsers we tested. It chewed through 81.2 percent of our CPU. But as a clean install, without Flash, Opera consumed 1.8 Gbytes and just *6.6 percent* of our CPU cycles. Pages seemed to load like shots from a gun: pow, pow, pow!

Firefox? Well, Firefox did swimmingly as well, when you removed Flash from the equation. It consumed 1.65 GB, and needed only 24.5 percent of the CPU. But after I downloaded Flash, Firefox seemed to throttle itself. The browser never climbed above 29.1 percent of the CPU, but some tabs were unresponsive minutes after loading, and I had to manually check each tab to check on its progress. That was totally unacceptable.

Chrome also consumed 4.23 Gbytes of memory, and 71.4 percent of

> But when I toggled Flash off, the same tabs required 4.12 GB of memory, and just 24.5 percent of my CPU. That's an 11 percent drop in memory consumed...

the CPU, with Flash enabled. That was pretty good, just by itself.

For Edge, some redemption

Of all the features that Microsoft highlighted with Edge—its Web
Notes, Cortana, the Reading View—the one that jumps out, now, is its
ability to toggle Flash off and on. Frankly, all the messaging I've seen
from Microsoft—and the reviews, to boot—have focused on its
performance on a few canned benchmarks, rather than real-world
browsing performance. And with Flash turned on by default, that
performance has been lousy.

I can't say for certain which pages require Flash to be functional, if
only because I've tolerated Flash for so long. But the toggle at least
offers the possibility that Edge can be the modern, streamlined
browser that Microsoft hopes it to be.

Edge, however, doesn't offer a middle ground. In Firefox, you can set
Flash in a "click to run" mode: Flash is installed, but it won't fire unless
you manually tell it to. (Chrome used to have a "Click to Play" option
for Flash, but it seems to have disappeared.) In Firefox, you'll need to
find the "Add-ons" menu, then set the Flash plugin(s) to "Ask to
Activate".) In Edge,
Flash is either on, or off.

Ideally, being able to
turn Flash on and off on
a per-tab basis might
be even better, but the
Edge team doesn't
seem to have that on
their feature roadmap.

*To toggle
Adobe Flash off
and on in the
Microsoft Edge
browser, you
need to dive
into the
Advanced
Settings menu.*

How do you turn off Flash?

If you already have a
browser with Flash
installed and think you
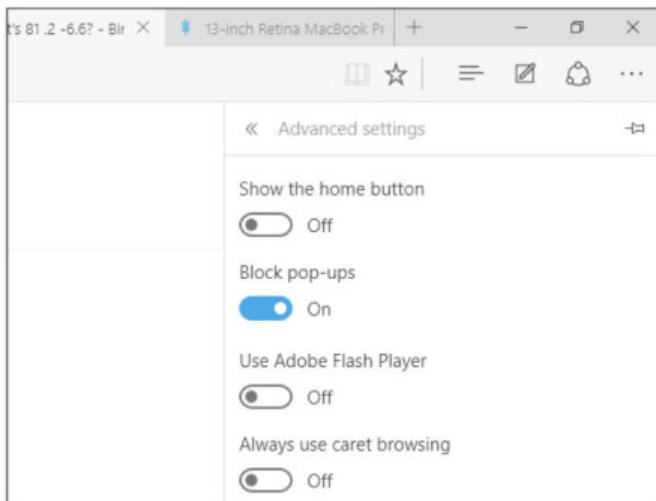
might do better without it, don't worry. Here's a quick guide to removing it:

Microsoft Edge: This is easy. Click the "ellipsis" (...) menu to the upper right, the Settings>Advanced Settings. Flip the Adobe Flash toggle to "Off".

Google Chrome: From the "hamburger" (three horizontal lines) menu in the upper right, click Settings, then scroll down to "Show advanced settings". Under "Privacy," click "Content Settings". Scroll down to "Plug-ins," then "Manage Individual Plugins". You'll have the option to turn Flash on or off.

Internet Explorer: Click the "gear" Settings icon to the upper right. Scroll down to "Manage add-ons". When you're presented with a list, click on the "Shockwave Flash Object" and the "disable" button, way down in the lower right.

Mozilla Firefox: In Firefox, you'll need to go to the hamburger menu in the upper right, then click the "Add-ons" menu, then set the Shockwave Flash plugin to "Never Activate".

Opera: This is a bit tricky. To uninstall Flash in Opera, you need to go to the Windows 10 Control Panel>Programs>Programs and Features menu, then manually uninstall Adobe Flash Player PPAPI. (Thanks to HowtoGeek for the tip.)

Stay tuned for our full review

Flash obviously isn't the only culprit preventing you from browsing efficiently: Javascript, other plugins, ads, and the like all bog down your browser and prevent it from seeing the content that matters. But as our tests prove, Flash certainly makes a tremendous difference.

Soon, we'll present our full set of benchmark results comparing the top browsers, and how they fare on Windows 10. Each has their own particular set of skills. What we'll tease you with, however, is the message we hope you take away from this: eliminating Flash can make a world of difference in your day-to-day browsing, and is just as important as any benchmark.

Hands-on: Lenovo's Miix 700 looks and feels like a Surface, but better

The Lenovo Miix 700 is a Lenovo Surface, plain and simple.

BY MARK HACHMAN

THE LENOVO IDEAPAD Miix 700 is simply a Lenovo Surface—just a bit better.

That might not be the most intriguing way of introducing Lenovo's Surface clone, but it's the most accurate. Place them side by side, eliminate some of the external markings, and you'd be hard-pressed to

tell the difference between the two.

But which Surface? It depends on which one you're comparing Lenovo's tablet against. The Miix 700 is a 12-inch tablet, the same form factor as the Surface Pro 3. But with processors reportedly ranging up to the new Skylake Core m7 (Lenovo demonstrated it with a Core m5 at its stand at IFA) it might be more on a par with the Surface 3. The Miix 700 can be configured with up to 8GB of memory, and will run Windows 10.

As for the price, well, it's somewhere in the middle: $499 for the Surface 3, $799 for the Surface Pro 3, and a starting price of $699 for the Miix 700. We've heard that it should be out in the United States this fall, most likely in November.

Why this matters: We've yet to see the Surface Pro 4 or Surface 4 from Microsoft (reportedly, that's all happening in November). But for now, Lenovo is offering a cheaper Surface Pro 3 that steps down a bit in performance. Yes, it's a Surface clone—but don't mock Lenovo for that. I suspect that this was done with Microsoft's blessing, as Microsoft has indicated that it plans to blaze a trail with new products to empower the industry, and not just itself.

Surface, reMiixed

If you've ever used a Surface, you'll be right at home with the Miix 700. Yes, there's a kickstand, with the full range of motion as found in the Surface Pro 3. The Miix also adds the styling of the Yoga hinge, although that doesn't seem to make any functional difference.

The screen resolution is 2160 x 1400, the same as that on the Surface Pro 3. Even the way that the keyboard folds back and connects via a long rectangular hinge is similar to the way that Microsoft does things. If I had to guess, Lenovo likely packed that space behind the

tablet screen with a battery. With a 4.5-watt Core M chip hiding behind a larger, SP3-style screen, I'd estimate the Miix 700's battery life to be pretty darn good—at least 8 hours.

And that keyboard is decidedly Lenovo. Instead of the closely spaced keys of the Surface and Surface Pro Type Covers, the Miix 700's keys are smaller, spaced out a bit, and offer much more resistance. I can't say which you'll prefer; my fingers have become used to gliding over the smooth expanse of the Surface keyboards, but Lenovo fans will undoubtedly find much to like here.

> I'd estimate the Miix 700's battery life to be pretty darn good— at least 8 hours.

Reportedly, Microsoft plans to launch a Surface Pro 4 and possibly a Surface 4 at an event in October. It's a safe bet that the next Surface Pro 4 will add an Intel Skylake chip, and thus more performance. That's going to help it pull away from the Surface Pro 3 and the Miix.

If you own a Surface 3 or a Surface Pro 3, keep them—they're solid products. But if you're interested in a new Surface-style PC, definitely add Lenovo's tablet to the, um, mix. ⏻

Hands-on with iPad Pro and Apple Pencil, built for getting stuff done

Apple's answer to the Surface Pro tablets is built for work, with a huge screen perfect for multitasking and an Apple Pencil for precision design and artistry.

BY SUSIE OCHS

Five years after its launch, the iPad is growing up. The new iPad Pro (apple.com/ipad-pro), introduced at Apple's media event recently, blurs the line between iPad and MacBook just a little more, with a

12.9-inch screen capable of running two apps side by side without either of them feeling cramped in the slightest.

But as large as it is, the iPad Pro doesn't feel unwieldy, even to me, an avowed fan of the iPad mini. We've learned from both the iMac and the iPhone that people love giant screens with tons and tons of pixels crammed on to them, and that's what the iPad Pro delivers, along with performance that should let more people than ever leave their laptops at home.

Thin and light

The iPad Pro is only 1.57 pounds, which is astonishing since my first-generation iPad is *still* in active service at my house, and it weighs 1.54 pounds. The iPad Pro is so much bigger but doesn't feel unbalanced or awkward. I could hold it easily, but—and I realize you'll make fun of me for this, and that's OK—I sort of wished it had a kickstand like the Surface Pro.

It's the size of a big magazine, or a clipboard. But it doesn't feel unwieldy.

But once you have it propped up just how you like, the iPad Pro's screen looks amazing. At 2732x2048 resolution, it's got 5.6 million pixels, and the short side has as many pixels as the longer side of an iPad mini. I was impressed with the responsiveness of iOS 9 on this tablet, as I easily pulled out the sidebar and entered Split Screen view.

Pencil power

You don't need a stylus to use any iPad, and the iPad Pro is no exception. Luckily, the Apple Pencil (apple.com/apple-pencil) isn't a stylus. It's not aimed at pointing and tapping things you can reach just fine with your fingers, thanks. Rather, it's for pressure-sensitive drawing and painting in apps as simple as Apple's own Notes app, or as complex and professional as the demonstrated Procreate or AutoCAD.

The Pencil felt great from the moment I picked it up. It feels like a pencil, very natural (although you can say the same for other smart Bluetooth styluses on the market), and using it felt natural too. Sensors can detect the pressure and angle, so it was effortless to

Apple Pencil is a $99 add-on that only works with the iPad Pro.

create lines of different thicknesses. The Notes app even has a ruler that let me draw perfectly straight. Using the side of the Pencil's tip created realistic shading, like using the side of a pencil lead.

A Lightning connector hidden in the end of the Pencil lets you plug it right into the iPad Pro for charging. An Apple rep told me that its quick-charging feature lets it grab enough juice for another hour or so of work in just a few minutes, and a full charge should last all day. You can plug it into an AC charger with an adapter that I didn't get to see—and I dearly hope is included in the purchase price.

Apple also created its own Smart Keyboard (apple.com/smart-keyboard), similar in appearance to the Touch Covers that Microsoft makes for the Surface tablets. It closes around the front of the iPad Pro and flips back to form a stand, just like the Smart Covers Apple has made for a while. But it has a built-in, fabric-surface keyboard with short key travel similar to the new MacBook. Third-party keyboards will be able to use the iPad Pro's Smart Connector, which powers and pairs the keyboard for you automatically—Logitech just announced one (go.pcworld.com/logitechipadkeys). I actually didn't get hands-on with it—by the time I got all the photos and video I needed of everything else, it was getting late and they were packing it up. But that's OK, because my colleague Jason Snell wrote his *More Color* column on *his* hands-on time with the Smart Keyboard (go.pcworld.com/snellsmartkeyboard), so we're all in luck. (Thanks, Jason.)

The Lightning connector for charging is hidden in the end of the Pencil.

You can charge the Pencil directly from the iPad Pro, or use a charger with the help of (sing it with me) an adapter.

More of the same, FTW

Apple talked about how much faster the iPad Pro's A9X chip is than the A8X in the iPad Air 2, but remained characteristically mum about details like how much RAM it has. Apple has teamed up with IBM to create iPad apps to be used for all kinds of work, since anything a clipboard can do, an iPad can do *so* much better, and having a laptop-quality iPad Pro on the high end of the line can open up more possibilities for people who need big power in a package that's half a pound lighter than the MacBook. My demo running splitscreen Microsoft Office apps was impressive, but when developers put the pedal to the iPad Pro's Metal, it's going to be fun to see what happens.

The new iPad Pro starts at $799 for a 32GB model with Wi-Fi. If you want more storage, there's a 128GB model (nope, no 64GB) with Wi-Fi for $949. Gotta have cellular? Your only option is a 128GB version for $1079. The Pencil is $99 and the Smart Keyboard is $169. Everything ships in November. ⏻

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AMD Radeon R9 Nano: A powerful taste of the PC's incredible shrinking future

There's no other graphics card quite like the AMD R9 Nano, which packs full-size performance into its six-inch frame—but it's not for everyone.

BY BRAD CHACOS

AMD DESERVES SOME serious props for even creating the Radeon R9 Nano (go. pcworld.com/r9nano) in the first place.

This pint-sized powerhouse is the latest in a long line of AMD technical innovations that skate to where the puck is going, rather than where the puck is lingering today. Built around revolutionarily tiny—and fast—high-bandwidth memory, the six-inch Radeon R9 Nano delivers flagship-level performance in a form factor that fits where most other graphics cards simply can't.

In an age where graphics cards keep expanding with heat pipes and heat sinks and fans in order to push performance to 11, the Nano's more holistic design approach is a breath of fresh air, dragging mini-ITX (mITX) graphics cards out from the shadows and into the spotlight. It truly feels forward-thinking—the first top-tier graphics card designed for a future where mainstream computing increasingly shifts towards NUCs and Steam Machines and small-form-factor designs and PCs-on-a-stick. There's no other card out there like quite it, and the Nano will bring tremendous joy to the people pining for its particular blend of high-end features.

But pushing the PC ecosystem forward isn't possible without some growing pains. The $650 Radeon Nano rocks, but it won't appeal to everybody—not by a long shot.

Let's dig in.

The Radeon R9 Nano inside a Lian Li mini-ITX case.

AMD Radeon R9 Nano under the hood

The $650 asking price for the Radeon R9 Nano shocked some people, but AMD's deft design of the Nano goes a long way toward justifying the flagship-level cost. This is the most powerful mini-ITX graphics

card ever created, and every aspect of it *screams* premium.

The Nano's six-inch length is its most notable feature, naturally, enabled by the tremendous space and power savings of high-bandwidth memory, which is integrated with the GPU. The card's a hair smaller in both length and width than Asus' GTX 970 DirectCU Mini, the Nano's closest GeForce-based miniature competitor. (Nvidia doesn't offer mini-ITX variants of the GTX 980 or 980 Ti.)

And it's downright *puny* compared to the hulking Asus Strix Fury. The Fury is AMD's other air-cooled graphics card built around a Fiji GPU and cutting-edge high-bandwidth memory.

We placed the Radeon Nano next to a pencil and a battery for yet more scale. It's small.

The Nano takes its design cues from AMD's *other* flagship, the also $650, water-cooled Radeon R9 Fury X. The Nano features a black metal shroud with a soft-touch aluminum finish, with RADEON emblazoned in bright red across its front and outer edge. It lacks a backplate, however, and for cooling it sticks to a single fan integrated in the shroud, sitting atop a card-length heat sink with horizontal fins. The

Now that's a cooler. The Radeon R9 Nano's cooler, to be exact.

GPU itself stays chilly thanks to a hybrid flattened-heatpipe/vapor-chamber solution. There's even a dedicated copper heatpipe just for the Nano's voltage regulator module.

Our deep dive into the Nano's design shines even more light on its inner workings, but the important part is that the cooling setup works well, as you'll see once we wade into benchmarks. That's a good thing, because AMD says customized Nanos from its graphics vendor partners (like Asus and Sapphire) won't necessarily be available. If they ever are, it'll be at least three months after launch—and even then, third-party vendors won't be allowed to touch the GPU's base specs.

Speaking of which, those specs are no joke. The Radeon R9 Nano packs the same full-fat, 4096 stream processor-strong Fiji graphics processor as the Fury X, along with the same 4GB of HBM. The Nano's GPU isn't an exact mirror of its bigger sibling, however: In order to squeeze Fiji into a mITX form factor without liquid cooling, AMD reduced the clock speed of the Nano's GPU enough to allow the card to consume a mere 175 watts of energy over a single 8-pin power connector. The Fury X, on the other hand, requires two 8-pin connectors and 275W.

There's more to it than the listed specs, however. On paper, the Fury X is clocked at 1050MHz, while the Radeon R9 Nano hits up to 1000MHz—but the Nano uses an aggressive version of AMD's PowerTune technology to dynamically adjust the clock speeds to meet the card's thermal and power targets. Observing real-time clock specs for the Nano using GPU-Z, it ran at 650MHz to 680MHz in the

AMD Radeon R9 Nano
Product Specifications

Process	28nm
Stream Processors	4096
Compute Units	64
Engine Clock	Up to 1000 Mhz
Compute Performance	8.19 TFLOPs
Texture Units	256
Texture Fill-Rate	256 GT/s
ROPs	64
Pixel Fill-Rate	64 GP/s
Z/Stencil	256
Memory Configuration	4GB HBM
Memory Interface	4096-bit
Memory Speed / Data Rate	500 Mhz / 1.0 Gbps
Memory Bandwidth	Up to 512 GB/s
Power Connectors	1 x 8-pin
Typical Board Power	175 W
PCIe Standard	PCIe 3.0
API Support	DirectX 12, Vulkan
FreeSync Support	Yes
Virtual Super Resolution	Yes
Frame Rate Target Control	Yes

Furmark benchmark (which both AMD and Nvidia call a "power virus"), typically 859MHz to 926MHz in 3DMark's Fire Strike (though it dropped to 700MHz during the last, most stressful scene), and 852MHz to 917MHz in *Middle-earth: Shadow of Mordor*.

That seems like a recipe for stuttering and frame rate issues, but nope: Games ran like a champ, while the card stayed cool and relatively quiet. AMD said the Nano would outpunch the older Radeon 290X flagship while using drastically less power, and spoiler alert: It does.

It also drastically outperforms the GeForce GTX 970, the most powerful mITX graphics card in Nvidia's arsenal. Heck, the downclocked Fiji GPU in the Radeon R9 Nano even trumps a full-sized GTX 980 in most cases.

PCWorld's faithful graphics card testing system was pressed into action yet again for this review, loaded with all sorts of high-end parts See the our testing and gameplay benchmarks (go.pcworld.com/r9nanotests).

So there you have it: All of AMD's claims for the Radeon R9 Nano proved true in real life. This pint-sized powerhouse is one of the most capable graphics cards around, flirting with performance on a par with the Asus Strix Fury, a full-sized card with an imposing cooling setup. It demolishes the GTX 970, Nvidia's most capable mITX graphics card. It
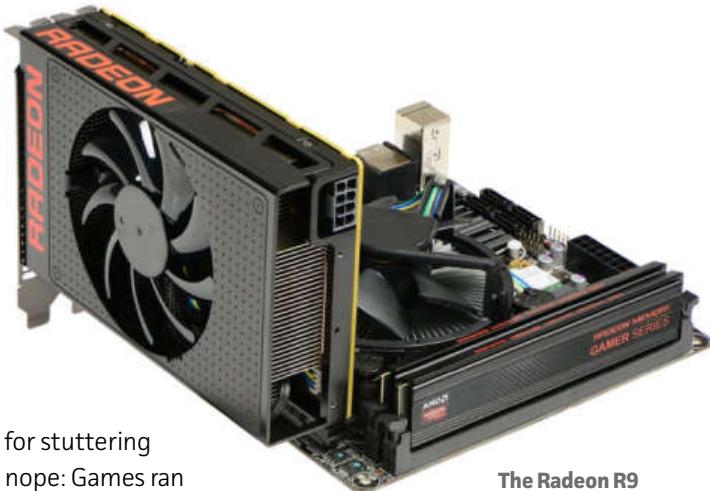
The Radeon R9 Nano on a mini-ITX motherboard.

AMD said the Nano would outpunch the older Radeon 290X flagship while using drastically less power, and spoiler alert: It does.

runs cool and quiet, and it manages to outpunch both the 290X and 390X while using far less power.

There's no other graphics card like it. If you want uncompromising gaming performance from a mini-ITX PC and play at resolutions higher than 1080p, the Radeon Nano is easily the most powerful option available. Its diminutive stature and cool performance will allow it to fit into itty-bitty cases that full-sized graphics cards couldn't even dream of squeezing into.

"For anyone who wants to build a small form factor chassis capable of playing 4K, the Nano is really interesting and that's exactly where we targeted it," AMD's Victor Camardo said at a Nano press briefing last month. "For those people who want power efficiency, who want high-performance, who want a good overall gaming solution that's optimized to take advantage of all aspects of the product, and not just push one curve or the other to the max."

The AMD Radeon R9 Nano does just that. It feels unique. It feels forward-thinking, a harbinger in a world increasingly focused on cramming full PC performance into ever-smaller cases. And more than that, it feels premium, oozing style from every fiber of its being. People may scoff at the Nano's $650 cost, but it manages to

trade performance blows with the $580 Strix Fury and $530 EVGA GTX 980 FTW despite its far more diminutive stature and enviable power efficiency.

It's amazing. A hell of a graphics card. The Radeon Nano fully justifies its $650 price point.

But most people shouldn't buy it.

Stumbling points

The Nano isn't just a niche product, it's an ultra-niche product—more a showcase for the space- and power-savings of HBM and Fiji than anything else. Currently, there are only a handful of (admittedly gorgeous) PC cases small enough to fit the Nano, but too compact for a larger graphics card. If size isn't an issue, it makes more sense to spend your $650 on the far greater performance of a Fury X or GTX 980 Ti. (See: *PCWorld*'s recent mITX build starring AMD's liquid-cooled Fury X.)

What's more, some technical issues hold back key would-be use cases for the Nano. At this size, the Nano just begs to be used in a killer home theater PC designed around a 4K TV… but the card's lone HDMI port is 1.4a, not 2.0, which means it's limited to 30Hz at that resolution. To be fair, Nvidia's HDMI 2.0-equipped high-end GeForce cards lack HDCP 2.2 support so they can't play protected 4K content, either. It's still a bummer in a card like the Nano, however. To find a graphics card with HDMI 2.0, HDCP 2.2, and H.265 encode/decode, you have to look to the $200 GTX 960 or $160 GTX 950, which don't offer anywhere near the gaming performance of the Radeon Nano.

Likewise, the small size and big-time performance of the Radeon Nano would make it seem well-equipped for Valve's impending Steam

The HDMI 1.4a port on the Radeon R9 Nano hurts its claim to king of the HTPC throne.

Machine army, but SteamOS is based on Linux, and frankly, AMD's Linux drivers don't perform well at all (though they're working on it).

Finally, our lingering concerns about the air-cooled Fury still apply to the Radeon Nano. Yes, it's capable of gaming at 4K resolution—but only at 30 fps to 50 fps on High graphics settings in most games. The golden standard for PC gaming is 60 fps, so you'll either need to pick up a FreeSync monitor to smooth out your gaming or dial the resolution back to 2560x1440, where the Nano rules the mITX roost—by far—but the GTX 970 mITX still puts on an admirable show. And at 4K, the Nano's 4GB of HBM is fine now, but I'd be worried about the long-term prospects of so little memory in future games at such high resolutions.

Add it all up, and you're looking at a fairly niche market for the Nano—and gorgeous, powerful flagship products for niche markets always command a price premium. The Nano is easily worth the $650 for someone who needs its unique blend of features. Mini-ITX gaming PCs don't need to compromise performance for size anymore.

Finally, let's loop back to where we began: AMD deserves serious props for pushing HBM's birth and creating this card in the first place. This is innovation. HBM's radical power efficiency and space savings is the future of graphics card memory, and small form factors are increasingly becoming the new norm in desktop PCs, flogged on by the energy efficiency in Intel's recent chips.

The AMD Radeon R9 Nano gives us a glimpse of that future today, fully earning its flagship status and hopefully—hopefully—encouraging case manufacturers and the rest of the component ecosystem into further investments in itty-bitty gaming PCs. The Radeon R9 Nano may not make sense for most gamers today, but I'm thankful it exists, and I can't wait to see the next version. ⏻

> AMD deserves serious props for creating this card in the first place.

Up close with the Asus ROG GX700, a massive, watercooled gaming notebook

The Asus ROG GX700 kicks off a new generation of watercooled, overclockable gaming notebooks.

BY MARK HACHMAN

When Asus announced the Asus ROG GX700 (go.pcworld.com/rog-gx700) at IFA in Berlin, we knew its massive cooling block would be one of the must-sees of the show. We weren't disappointed. On the other hand, what they showed was just a semi-functional prototype. So although we spent some hands-on time with it, we can describe only in vague detail what's going on inside of it.

Asus has yet to reveal any specs. We can be almost certain that one of Intel's new, overclockable Skylake chips is inside. One Asus employee told us it would include the forthcoming Nvidia GTX 990M, but we can't confirm that. All we do know is that the watercooling system inside the notebook will cool both the GPU and CPU.

And oh, what a watercooling system it has. Detached, the ROG GX700 laptop runs normally, using air to cool both the CPU and GPU. It's hefty, weighing well over five pounds. As of now, Asus plans for it to have a 17-inch, 4K IPS display.
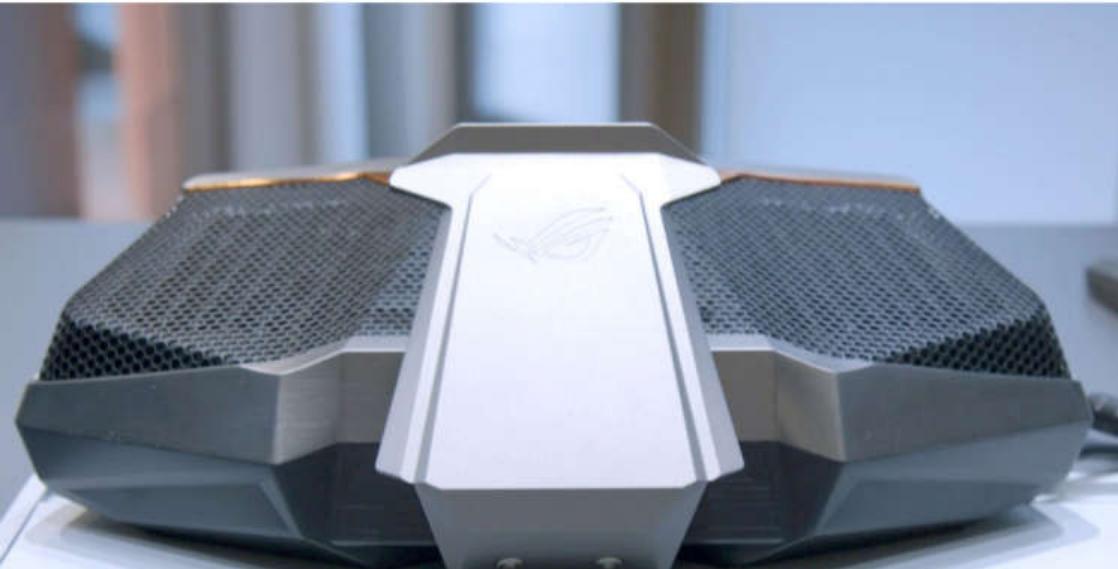
Like docking the Starship Enterprise

Docking the laptop is no simple feat. It must be lowered onto two vertical pins that align the laptop just so. Afterward, you'll need to fasten a clamp that tightly connects it to that crazy external cooling system. All this is to ensure a snug fit between the central power port and the coolant channels that flank it.

When you dock the notebook correctly, a klaxon-like sound rings out, and lights flicker in the depths of the cooling unit. To undock it, you need to press a rather stiff button in the center of the cooling unit, which pops the notebook up and out.

Because the demo unit wouldn't boot—nor was it, presumably, circulating coolant—we don't know whether you'll need to shut down the laptop before docking or undocking it, or whether you'll have to worry about coolant drips each time you use it. And, of course, we have no idea of how the notebook will perform. Asus claims it'll provide 80 percent more performance than a normal laptop using the same parts, but lacking the external cooler.

The GX700's power port is in the center, flanked by the cooling channels.

   Because the cooling unit is massive, there's very little chance you'll be toting this thing around. But it's an intriguing design nevertheless. Even if gamers don't opt for the ROG GX700's massive cooling rig, Asus or other notebook manufacturers might be able to adapt the design. The end goal for a number of PC gamers would be something that could serve as a business notebook by day and a gaming notebook by night. The ROG GX700 was designed exclusively for gamers, but you just never know what the future holds. ⏻

AMD Radeon R9 380 feat. VisionTek: The best $200 graphics card you can buy

A little bit of extra oomph in the clock speeds help make it the most enticing option for mainstream gamers today.

BY BRAD CHACOS

THE BATTLE FOR PC gaming's sweet spot is on.

The $150 to $200 price range is crucial for AMD, Nvidia, and all of their assorted partners. The overwhelming majority of graphics cards sold cost less than $200, with cards in that price range delivering a solid 1080p experience in modern games—and over 50 percent off all PC gamers rock 720p or 1080p displays, according to the Steam hardware survey. Mainstream graphics cards are a big deal.

Case in point: Just last month, Nvidia released a new GeForce GTX 950 graphics card in order to snatch the $150 crown away from AMD's Radeon R7 370. That prompted AMD to release a more powerful R9 370X in some parts of the world.

The tables turn when you hit the $200 mark. First revealed at E3, the Radeon R9 380's "Tonga" graphics processor is the same one found in
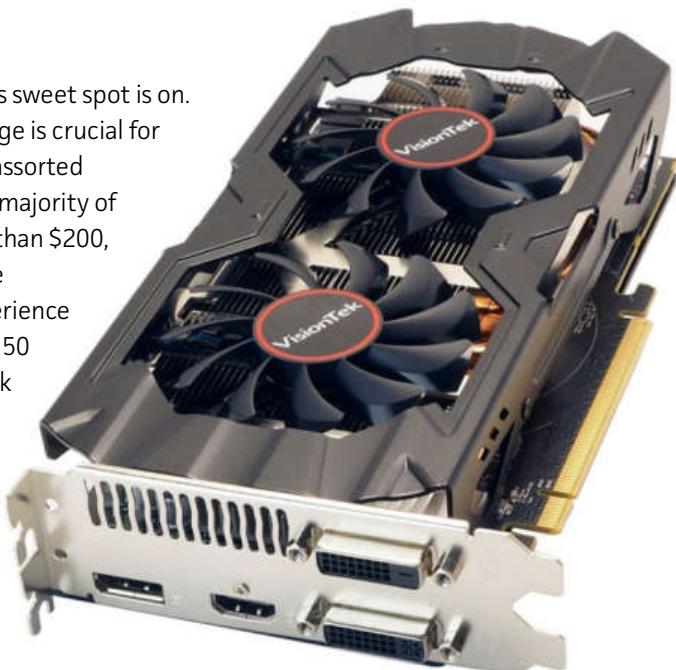
the R9 285, which first launched in August 2014. But don't let the rehashed GPU dissuade you: The Radeon R9 380 is loaded with support for AMD's newest features and delivers the best raw performance you can find for $200 today, surpassing Nvidia's $200 GeForce GTX 960—albeit at the expense of much higher power usage.

Meet the new mainstream 1080p champion. Let's dig in.

Inside the Radeon R9 380

You won't find much new inside the R9 380 that wasn't already available in the R9 285. Glancing over the spec sheet below, the only noticeable difference between the two is that the max clock speed was nudged up from 918MHz in the R9 285 to 970MHz in the "new" R9 380. The memory speed also received a borderline-negligible 100MHz bump.

Because of that, we won't spend much time detailing the Radeon R9 380's deepest, darkest details—just check the chart on the next page if you're interested. It's available in models with 2GB or 4GB of memory, and since the Tonga GPU is still relatively new—August 2014 wasn't *that* long ago—the R9 380 packs full support for DirectX 12 and helpful AMD features like FreeSync, Virtual Super Resolution, and Frame Rate Target Control, *unlike* the $150-and-up Radeon R7 370, which is based on a GPU from 2012.

VisionTek kindly sent us one of its 2GB R9 380s for testing, and you couldn't ask for a better representative. The VisionTek Radeon R9 380 (go.pcworld.com/visiontekr9380) sticks to stock specs from clock speeds to memory configuration, but spruces things up with a nice dual-fan custom cooling solution featuring a card-length heat sink and copper heat pipes. Those heat sink fins run across the length of the card to help vent heat out of the rear more easily, a design feature that AMD itself recently crowed about when introducing the Radeon R9 Nano.

A rigid, black metal backplate—shown on the previous page—is another nice touch, as is VisionTek's limited lifetime warranty on the

	AMD Radeon™ R9 390X	AMD Radeon™ R9 390	AMD Radeon™ R9 380	AMD Radeon™ R7 370	AMD Radeon™ R7 360
Process	28nm	28nm	28nm	28nm	28nm
Stream Processors	2816	2560	1792	1024	768
Engine Clock	Up to 1050MHz	Up to 1000MHz	Up to 970 MHz	Up to 975 MHz	Up to 1,050 MHz
Compute Performance	5.9 TFLOPs	5.1 TFLOPs	3.48 TFLOPs	2.00 TFLOPs	1.61 TFLOPs
Texture Units	176	160	112	64	48
Texture Fill-Rate	184.8 GT/s	160.0 GT/s	108.64 GT/s	62.4 GT/s	50.4 GT/s
ROPs	64	64	32	32	16
Pixel Fill-Rate	67.2 GP/s	64.0 GP/s	31.04 GP/s	31.2 GP/s	16.8 GP/s
Z/Stencil	256	256	128	128	64
Memory Configuration	8GB GDDR5	8GB GDDR5	2GB/4GB GDDR5	2GB/4GB GDDR5	2GB GDDR5
Memory Interface	512-bit	512-bit	256-bit	256-bit	128-bit
Memory Speed / Data Rate	1,500MHz / 6.0Gbps	1,500MHz / 6.0Gbps	Up to 1,375/1,425MHz / Up to 5.5/5.7Gbps	Up to 1,400MHz / Up to 5.6Gbps	Up to 1,625MHz / Up to 6.5Gbps
Memory Bandwidth	Up to 384 GB/s	Up to 384 GB/s	Up to 182.4 GB/s	Up to 179.2 GB/s	Up to 104 GB/s
Power Connectors	1 x 6-pin, 1 x 8-pin	1 x 6-pin, 1 x 8-pin	2 x 6-pin	1 x 6-pin	1 x 6-pin
Typical Board Power	275W	275W	190W	110W	100W
CI-E Standard	PCI-E 3.0	PCI-E 3.0	PCI-E 3.0	PCI-E 3.0	PCI-E 3.0
API Support	DirectX® 12, Vulkan™, Mantle	DirectX® 12, Vulkan™, Mantle	DirectX® 12, Vulkan™, Mantle	DirectX® 12, Vulkan™, Mantle	DirectX® 12, Vulkan™, Mantle
FreeSync Support	Yes	Yes	Yes	No	Yes
Virtual Super Resolution	Yes	Yes	Yes	Yes	Yes
Frame Rate Targeting Control	Yes	Yes	Yes	Yes	Yes

Tech specs for the entire Radeon R300 series family.

card if you register it within 30 days of purchase. That drops to one year if you don't register. The killer warranty and thoughtful build quality isn't free, however, as VisionTek charges $230 for this particular card.

Connectivity-wise, the VisionTek Radeon R9 380 offers DVI-D, DVI-I, HDMI 1.4a, and DisplayPort, the last of which is a must-have if you're thinking of investing in a FreeSync monitor to make your PC games super-smooth.

As ever, we tested the VisionTek Radeon R9 380 on PCWorld's dedicated graphics card benchmark system. See the benchmark results at go.pcworld.com/visiontekr9380tests.

Bottom line: The new 1080p champ

Add it all up and there's only one conclusion to reach: Despite the higher power draw, the Radeon R9 380 is clearly the best graphics card for the money in the $200 price range. It consistently out-performs the heavily overclocked GTX 960 SSC in everything but *GTA V*, though Nvidia's card hangs closely enough to be tempting if the R9 380's power draw is a concern, or if you're building a home theater PC and need an HDMI 2.0 port to output a 60Hz signal to a 4K TV. (The GTX 950 supports HDMI 2.0; the Radeon R9 380 is limited to HDMI 1.4a's 30Hz at 4K.)

For your money, you'll get a *mostly* uncompromising mainstream 1080p gaming experience, hovering around 60fps at Ultra settings in many cases, though you may need to tone down some of the more extreme anti-aliasing options or set the graphics options to High in

some of most strenuous titles—but only if the 60fps barrier is sacrosanct to you. If you're fine with a console-quality 30fps, the VisionTek Radeon R9 380 never faltered below that mark, even with all the bells and whistles enabled in the most strenuous games.

But if console-quality graphics aren't a bother, you can save some money by dropping down to the $150-$170 price range, where the tables turn and Nvidia's GeForce GTX 950 reigns supreme. Graphics cards in that range can hit 40fps-plus at 1080p on High graphics settings.

For most people, we'd recommend saving your pennies for a few weeks more and stepping up to the $200 price range. The leap in graphics performance is massive, delivering a much more compelling 1080p gaming experience for a price that still won't break the bank. It's crazy how much performance you can get for $200 these days (though the R9 380 is *not* an upgrade from the older R9 280 and 280X, which were priced higher).

When Nvidia's GeForce GTX 960 made its debut, we said that AMD needed to drop the Radeon R9 285's price to $200 to remain competitive. With the Radeon R9 380, AMD did just that—and the little bit of extra *oomph* in the card's clock speeds help make AMD's offering the most enticing for mainstream gamers today.

As far the specific vendor implementation goes, the VisionTek Radeon R9 380's stock-clocked offering may not push the envelope as fiercely as some other custom-cooled designs on the market, but the overall package is very clean and competent indeed, and that limited lifetime warranty is pretty darn enticing. ⏻

We'd recommend saving your pennies for a few weeks more and stepping up to the $200 price range.

Intel Core i7-5775C: The unwanted desktop Broadwell has one neat trick

This chip arrived already obsolete, but benchmarks comparing it to Haswell and AMD Godavari show its true colors.

BY GORDON MAH UNG

THE NARRATIVE IS already in place on Intel's new Broadwell for desktop CPU: It's the chip no one wanted.

As someone who watched this story unfold, I know the truth is actually the opposite. You see, Intel's 3.3GHz Core i7-5775C is actually something the Internet *demanded*.

Remember that in 2012, the Internet said Intel would effectively "kill the desktop" PC because the company had no plans for a socketed CPU past Haswell.

The truth is, Broadwell was always intended as a lower-power part with no practical appeal outside of laptops, NUC-style computers and all-in-one PCs. Instead, Intel told me at the time, desktop sockets will get a workout with the next big thing: Skylake.

Anger and hand-wringing ensued. Soon, bowing to pressure from its die-hard desktop community and PC vendors, Intel rolled over and decided to make a socketed version of Broadwell.

That brings us to the new Core i7-5775C—the CPU Intel never wanted. Now it looks like not even the crowd that demanded the chip will want it.

What Broadwell is

Intel announced 10 Broadwell CPUs in June at Computex. Half will go into laptops, and another three will be soldered on motherboards in all-in-one or Mini PCs, as Intel originally planned. But of those 10, two will fit into the traditional socket that desktop users want. That's what

Processor Number	Cores/Threads	Base Freq (GHz)	Graphics	Price	L3 Cache	TDP
i7-5950HQ	4/8	2.9	Intel Iris Pro graphics 6200	$623	6M	47W
i7-5850HQ	4/8	2.7	Intel Iris Pro graphics 6200	$434	6M	47W
i7-5750HQ	4/8	2.5	Intel Iris Pro graphics 6200	$434	6M	47W
i7-5700HQ	4/8	2.7	Intel Iris Pro graphics 5600	$378	6M	47W
i5-5350H	2/4	3.0	Intel Iris Pro graphics 6200	$289	4MB	47W
i7-5775C	4/8	3.3	Intel Iris Pro graphics 6200	$366	6M	65W
i7-5775R	4/8	3.3	Intel Iris Pro graphics 6200	$348	6M	65W
i5-5675C	4/4	3.1	Intel Iris Pro graphics 6200	$276	4M	65W
i5-5675R	4/4	3.1	Intel Iris Pro graphics 6200	$265	4M	65W
i5-5575R	4/4	2.8	Intel Iris Pro graphics 6200	$244	4M	65W

Here's Intel's new Broadwell quad-core team. The HQ denotes mobile CPUs, the R chips will go into all-in-one, and the C chips are socketed.

I'm looking at today.

The Core i7-5775C will work in most 9-series motherboards and systems out there with BIOS support. Just be advised, that's not exactly straightforward. To get my Core i7-5775C up and running, I didn't just have to update the BIOS; I had to update it the *right way*. Check with your motherboard maker if you plan to go with a Broadwell C part.

Broadwell is a 14nm-process CPU that should offer a 5-percent or so performance increase over Intel's 4th-generation Haswell CPUs, if all things were even. My own tests of Haswell vs. Broadwell (go.pcworld. com/hvb) mobile parts confirmed that.

Everything isn't even, though. The pair of Broadwell C chips Intel has produced feature a massive 128MB of Level 4 (L4) cache using

embedded DRAM. This cache is slower than the cache integrated into the CPU itself ,but because it's actually a chip sitting next to the CPU and wired directly to it, it's a magnitude faster than using system RAM.

This isn't a new trick. Intel actually sold three Haswell CPUs with a similar 128MB L4 cache aboard. Those CPUs were available only in NUC-style machines like the Gigabyte Brix Pro (go.pcworld.com/gbrix) and soldered down to the motherboard. Like the Broadwell desktop chip, the eDRAM's existence is mostly to address graphics performance, where memory bandwidth is king.

Although this chip isn't a socketed version, it gives you an idea of what Broadwell C looks like. The chip in the center is the CPU while the chip on the right is the 128MB of eDRAM cache.

How we tested

For my test, I used an Asus Z97-Deluxe motherboard with 16GB of DDR3/1600 and 240GB SSD. I updated the motherboard to the latest UEFI available, installed a fresh copy of 64-bit Windows 8 and hunted down the latest drivers as well. Because the graphics capability of the the Broadwell C is a driving feature, I tested it without a discrete GPU.

I realize that decision doesn't track with what most people are doing with these expensive CPUs. I'd bet it's close to 90 percent who pair higher-end CPUs with graphics cards for gaming. Still, the graphics performance of these chips is a very important feature.

The competitor was a natural choice: Intel's Core i7-4790K, aka Devil's Canyon.

The Core i7-4790K has a clock speed of 4GHz and will Turbo Boost up to 4.4GHz on some loads. It has Intel HD4600 graphics and on the street sells for $340. For more details, I've lined both them up (go.pcworld.com/compare) at Intel's ARK website. It's pretty much the pinnacle of quad-core Haswell performance.

Besides the Broadwell to Haswell generation difference, the other factor that matters here is the clock speeds between the two chips. The Broadwell Core i7-5775C has a base clock of 3.3GHz with a Turbo Boost of 3.7GHz.

Handbrake 0.10.2 x 264 encode (sec)

Core i7-5775C	2,963
Core i7-4790K	2,241

0   500   1,000   1,500   2,000   2,500   3,000   3,500
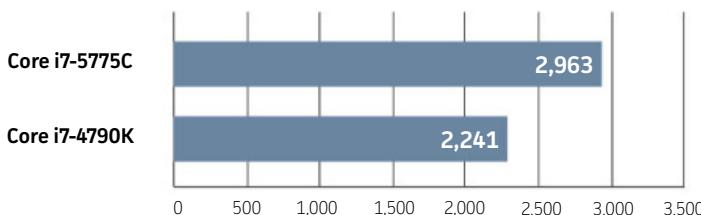
SHORTER BARS INDICATE HIGHER PERFORMANCE

Handbrake when confined to the x86 cores in the CPUs favors the higher-clocked Haswell chip over Broadwell.

Handbrake 0.10.2 QuickSync encode (sec)

Core i7-5775C	793
Core i7-4790K	958

0   200   400   600   800   1,000   1,200
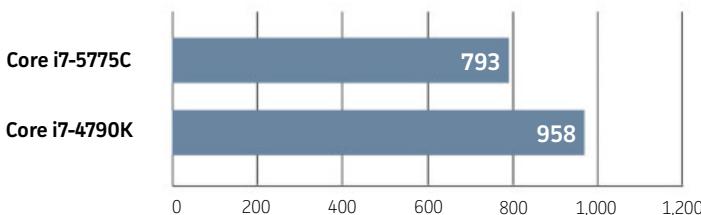
SHORTER BARS INDICATE HIGHER PERFORMANCE

As Madden says: Boom. Quick Sync on the Broadwell C stomps the higher-clocked Haswell CPU.

Encoding

The first test we can discuss is our Handbrake workload. We use the free and popular Handbrake encoder to convert a massive 30GB MKV file into a much more compact MP4 file using the Android Tablet preset. Notes: Our normal system review benchmark uses the 0.9.9 version but for this, I wanted to use the latest version of Handbrake 0.10.2. Because it does effect the encoding time, you can't compare results between the versions. Handbrake allows you to choose

different encoders so for the first one, I used x264, which is heavily multi-threaded and keeps the workload to the x86 cores in the CPU.

The result was a big win for the Core i7-4790K and clock speed in general.

But wait, encoding video isn't done just on the x86 side anymore. Today, encoding on the GPU is the way to go for performance, and Intel has dedicated transistors for hardware encoding into its chips, called Quick Sync. What happens when we give Handbrake the same task, but using the graphics cores instead?

Boom: The improved Broadwell graphics cores combined with its massive eDRAM flips this battle on its back. Besides whistling at how much of a recovery the Core i7-5775C made here, you should also take note of the encoding time it took using the GPU cores rather than the x86 cores in the CPUs. The Core i7-5775C, for instance, takes a third of the time to get the work done. There are arguments that GPU encoding leads to visual impurities, but when you're crunching a file down to watch on your phone, who cares?

3D rendering

Next up, we used Cinebench R15, a test based on Maxon's Cinema 4D animation package. It's a great benchmark that is pure CPU and heavily multi-threaded. The result is no surprise, as 3.7GHz even with the newer Broadwell cores can't beat 4.4GHz.
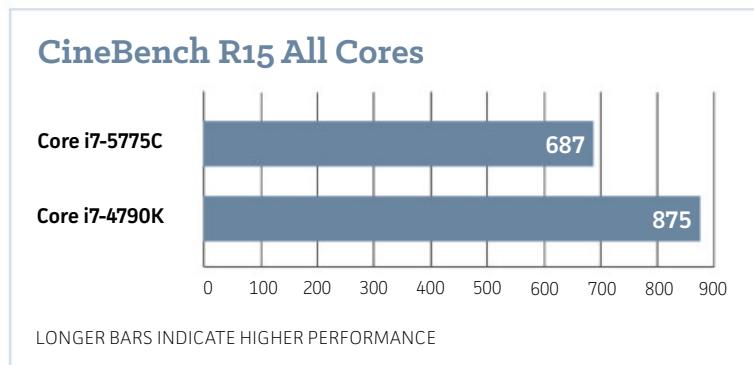
Clock speed wins. Again.

CineBench R15 All Cores

Core i7-5775C	687
Core i7-4790K	875

0 100 200 300 400 500 600 700 800 900

LONGER BARS INDICATE HIGHER PERFORMANCE

PCMark 8 Work Conventional

Core i7-5775C	3,518
Core i7-4790K	3,919

0   500   1,000   1,500   2,000   2,500   3,000   3,500   4,000   4,500
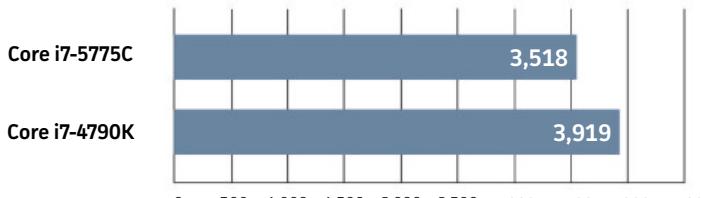
LONGER BARS INDICATE HIGHER PERFORMANCE

PCMark 8 Work Conventional measures simulated Office Drone performance.

Work performance

Our next test is PCMark 8, which simulates various computing tasks broken down into Work, Home and Creative categories. Work measures general Office Drone tasks, Creative throws in photo, video and light gaming, while Home factors in more casual gaming.

The first result is from PCMark 8 Work Conventional. Again, the Core i7-5775C's lack of clock speed shows even on these basic tasks that a Celeron could run.

Creative performance

Once PCMark 8 mixes gaming performance into this test, the Broadwell makes a nice comeback. The result is similar in the PCMark 8

PCMark 8 Creative Conventional

Core i7-5775C	3,804
Core i7-4790K	3,778

0   500   1,000   1,500   2,000   2,500   3,000   3,500   4,000
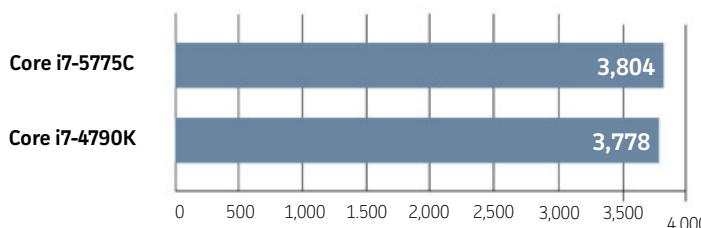
LONGER BARS INDICATE HIGHER PERFORMANCE

PCMark 8 Creative Conventional adds video and photo editing into the test load.

Home test, which adds gaming into the mix and puts the Broadwell in a much better light than the Haswell, thanks to its better gaming capability.

Chess performance

The Fritz 12 Chessbenchmark measures a CPU's ability to calculate chess moves. The yard stick is a 1GHz Pentium III. A score of 10 would mean the tested CPU is 10 times faster than a 1GHz Pentium III performing the same tasks. The results again don't look great for the Broadwell desktop part. Even though we know Broadwell's cores are

Fritz Chess Benchmark

Core i7-5775C	27.8
Core i7-4790K	35.5

Scale: 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0

LONGER BARS INDICATE HIGHER PERFORMANCE

The Fritz chess benchmark measures how fast a CPU is at calculating chess moves. Each of those "units" is the performance of a 1GHz Pentium III.
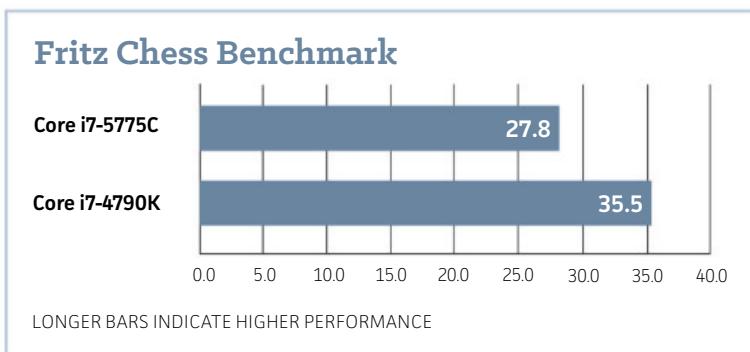
maybe 5 percent more efficient doing the same task, it's not enough to compensate for the higher clock speeds of the Core i7-4790K chip.

Where Broadwell really shines

On the compute side, the Broadwell desktop part can't hang with the higher clock speeds of the Haswell chip but what happens when the GPU is the primary driver of the task? It's a different situation.

For reference, I'm going to toss in the brand-new "Godavari" AMD A10-7870K chip. It's technically a 12-core CPU by AMD's standards, but that really means it's a quad-core CPU with eight GPU cores in it. The x86 cores run at 3.9GHz to 4.1GHz, and the integrated Radeon R7 graphics cores buzz along at 866MHz.

While AMD's x86 performance has been weak sauce these last few

Broadwell for desktop fits into existing Z97 motherboards.

years, the graphics performance has rained pain on Intel's just as badly. The best part of AMD's Godavari is its price. It's a chip with a $137 list price, but it's actually selling for more, at $149. That's less than half of either Intel CPUs. Some may cry foul at using the Godavari because it's so much cheaper, but I think it's fair to put the APU's graphics performance in context.

Note: I tested the A10-7870K with its RAM set to DDR3/1600 to match the Intel systems and also grabbed the latest Catalyst driver available.

Synthetic gaming performance

First up is the popular 3DMark. This is a great showing for the Core i7-5775C Broadwell chip when compared to the Core i7-4790K Haswell chip and shows just how far Intel has come. In fact, Intel has always said Broadwell was a minor tick in performance on the x86 side, but its graphics performance was a major tock. Helped by the eDRAM in the chip, that seems to be true. Intel has finally caught up with AMD's

3DMark Firestrike Graphics
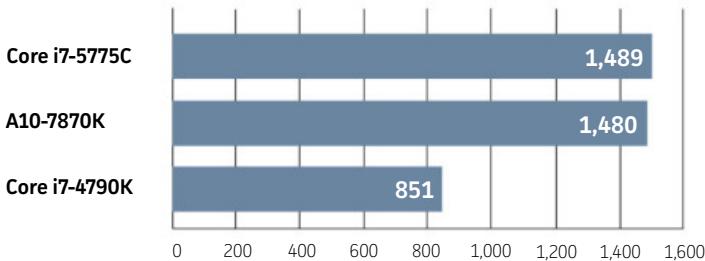
CPU	Score
Core i7-5775C	1,489
A10-7870K	1,480
Core i7-4790K	851

0 200 400 600 800 1,000 1,200 1,400 1,600

LONGER BARS INDICATE HIGHER PERFORMANCE

integrated graphics performance. Of course, there is that price discrepancy between the AMD and Intel chip to consider.

Firestrike is a little over the true capability of these CPUs so I also ran the easier Sky Driver test. Interestingly, the Core i7-5775C starts to pull away from the AMD A10-7870K in the overall score. That's likely due to the more efficient Intel cores, boosting its final scores higher.

3DMark Sky Diver Overall
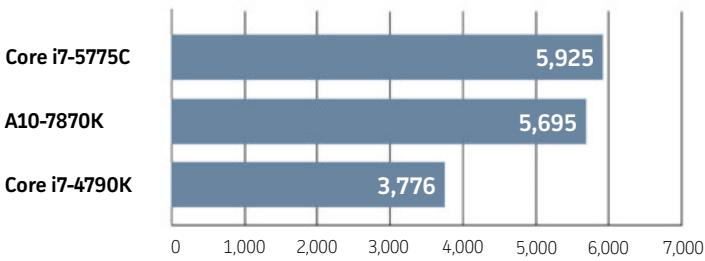
CPU	Score
Core i7-5775C	5,925
A10-7870K	5,695
Core i7-4790K	3,776

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000

LONGER BARS INDICATE HIGHER PERFORMANCE

Dirt Showdown

Enough with the synthetic tests. To see how the integrated graphics would perform in actual games, I threw Code Master's *Dirt Showdown* at all three. The result is a huge win for the Broadwell desktop chip.

Dirt Showdown 19x10 medium quality (fps)

Core i7-5775C	46.1
A10-7870K	32.8
Core i7-4790K	27.6

0   5.0   10.0   15.0   20.0   25.0   30.0   35.0   40.0   45.0   50.0

LONGER BARS INDICATE HIGHER PERFORMANCE
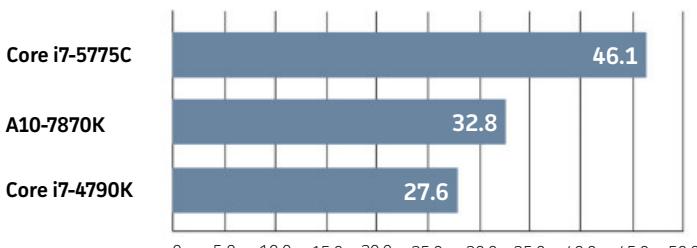
In a real game, the new Broadwell Core i7-5775C pulls away from the pack.

Dirt Showdown actually runs fairly well at 1920x1080 on all three, too. I would never play a first person shooter at 32fps, but in driving games, where you don't whip around like you do in a shooter, it's surprisingly tolerable.

BioShock Infinite

Moving on to Irrational Games' *BioShock Infinite*, a lot of visual quality settings had to be compromised to get to playable framerates. The result is a big win for the Core i7-5775C again. It leaves the AMD APU in the dust, and its sibling is a very distant third. If I were really attempting to play *BioShock Infinite* on integrated graphics, I'd notch it down to 1366x768 to get the frame rates higher.

Tomb Raider

The last game I ran was Square ENIX's *Tomb Raider*. Like the other games, it shines on the Core i7-5775C chip. At 1920x1080 resolution, the Broadwell chip can even run it at the magical 60+ frames per second. You make a lot of compromises in visual quality, though. I'd personally run it at 1366x768 at normal quality, where the game looks much better and the Broadwell can push 72 fps. The AMD A10-7870K interestingly takes a back seat to even the Core i7-4790K here. That

BioShock Infinite 19x10 low quality (fps)

	fps
Core i7-5775C	37.3
A10-7870K	22.4
Core i7-4790K	15.3

LONGER BARS INDICATE HIGHER PERFORMANCE

Tomb Raider 19x10 low quality (fps)

	fps
Core i7-5775C	64.4
A10-7870K	28.9
Core i7-4790K	35.4
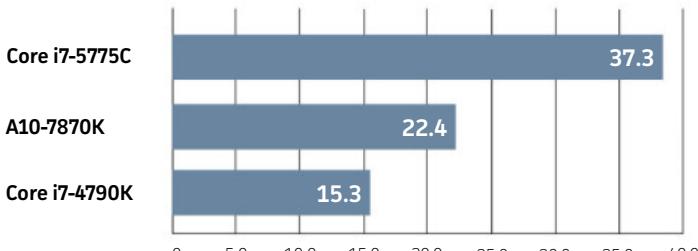
LONGER BARS INDICATE HIGHER PERFORMANCE

Bioshock Infinite isn't really playable at 1920x1080 on any of the CPUs.
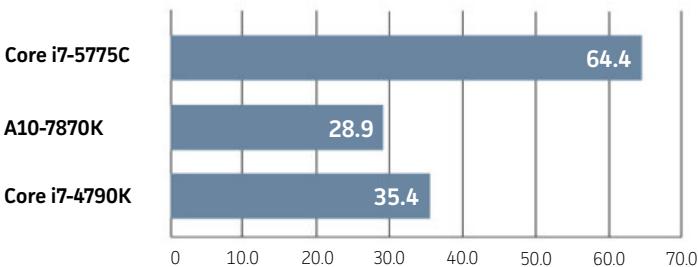
may indicate *Tomb Raider*'s dependence on the x86-side, and the AMD's chips weaker cores dragging it down a little.

OpenCL performance

The final graphics test I ran was Luxmark 3.0, a benchmark that measures OpenCL performance. OpenCL is a way to run general computing tasks on a graphics chip. The story is the same: the Core i7-5775C clocks the other two CPUs by a healthy margin.

The actual surprise is the A10-7870K, which loses badly to the Core i7-4790K chip. I didn't expect the Godavari to ace the Broadwell and

its big cache, but losing to the Haswell chip was a surprise.

Conclusion

There's no way to talk about the Broadwell socketed chip without talking about: Skylake. Intel's next desktop chip is shipping this fall, and Skylake is the rightful successor to Haswell. So why even waste time with Broadwell?

After all of my testing, I think that conclusion is probably the right one. If Broadwell in a socket had been introduced six months ago, it might have had a fighting chance. But now? No.

Skylake introduced a new socket with it. Would anyone in their right mind would build or buy a new system using a Broadwell chip?

Even the strongest argument for Broadwell in a socket is very niche.

Luxmark 3.0 Luxball GPU only

Chip	Score
Core i7-5775C	3,116
AMD A10-7870K	1,431
Core i7-4790K	1,873

0   500   1,000   1,500   2,000   2,500   3,000   3,500

LONGER BARS INDICATE HIGHER PERFORMANCE

Luxmark 3.0 is an OpenCL test and oddly, the AMD part gets burned by even the Haswell chip.
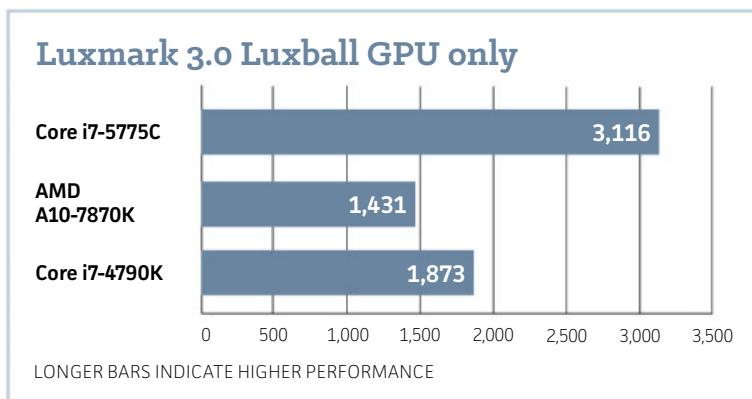
In general use, it's actually slower than the cheaper Haswell chip.

Broadwell's strongest point is actually as an integrated graphics chip. With its embedded DRAM it smokes all other integrated graphics you can buy today by a huge margin. It's actually capable of playing some games at 1920x1080 at the magical 60+ fps frame rate at lowered image quality settings, which is amazing for integrated graphics.

But who spends $366 on a CPU to play games without a graphics card? As good as the Core i7-5775C is for an integrated graphics chip, a $150 GPU would run circles around it. Take that $150 GPU and pair it

Broadwell is destined to live deep in the shadows of Intel's upcoming Skylake CPU.

with a $200 Core i5, and you'd get better gaming results.

You may certainly make some arguments that its best use would be in a space-constrained mini system or All-in-One PC but that's the perfect place for a soldered version of the chip, not a socketed version.

That's also just like Intel originally planned. ⏻

HELP KEEP THESE KIDS IN PLAY.

175,000 KIDS WILL BE DIAGNOSED WITH CANCER THIS YEAR.

Children are our greatest hope for the future. Let's be their greatest hope too.

Cancer strikes infants and children. For teens and young adults, survival can depend on treatment by a pediatric oncologist, designed specifically for them.

The St. Baldrick's Foundation and Stand Up To Cancer are funding groundbreaking collaborative research to bring the most effective therapies to kids fighting cancer. To learn how you can help keep these kids in play, go to stbaldricks.org/inplay and standup2cancer.org/pediatrics.

Julia Hernandez
Diagnosed at 16, in remission.

Samuel L. Jackson
Stand Up To Cancer and
St. Baldrick's Ambassador

St. Baldrick's FOUNDATION
Conquer Childhood Cancers

STAND UP TO CANCER

Photo by Nigel Parry

Windows 10: The best tips, tricks, & tweaks

By Brad Chacos

Windows 10 is chock full of handy, hidden new features worth exploring. Check out the best tips and tricks here.

Windows 10, Microsoft's back-to-basics re-embracing of the PC, is already brimming with handy new features (go.pcworld.com/w10first10), and with all the new goodies comes with a legion of new tweaks and tricks—some of which unlock powerful functionality hidden to everyday users.

Others, though, simply let you mold some of Windows 10's new features into the shape you see fit. Here are some of the most useful Windows 10 tweaks, tricks, and tips we've found. Be warned: Some of these may break as the operating system evolves, given Microsoft's new "Windows as a service" mentality.

MAKE CORTANA'S EARS PERK UP

Cortana's finally made the leap to the PC in Windows 10, assuming control of the operating system's search functions and dishing out just as much sass (go. pcworld.com/ w10cortanaeggs) as the Windows Phone version. But by default, she doesn't listen for your commands.

If you'd like to be able to just bark commands at your PC, open Cortana by clicking the search field in the taskbar and select the Notebook icon in the left-side options pane. Select Settings from the list, then simply enable the "Let Cortana respond when you say 'Hey Cortana'" option. You'll need an active microphone for this to work, of course.

While you're poking around Cortana's options, you can dive into the Notebook menu to fine-tune exactly what personal data Microsoft's digital assistant can access. Remember, however, that like Google Now, Cortana's effectiveness is directly related to how much she knows about you.
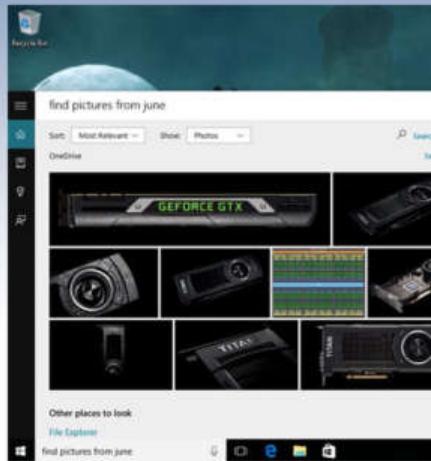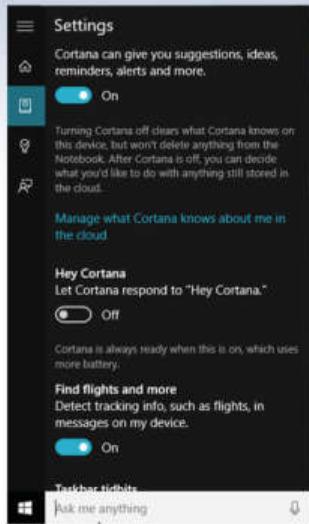
Powerful natural language search

Cortana can handle all sorts of commands you issue using natural language, such as playing music, creating reminders, or showing you the weather, but the most powerful use of her natural language abilities revolves around basic search capabilities. You can give Cortana basic commands like "Find pictures from June" or "Find documents with Windows 10" and she'll apply the appropriate filters, then scour your local files and OneDrive storage for results.

Customize your Start menu

Don't forget to make the Start menu your own. If you appreciate the blend of the traditional interface with the Live Tiles, note that you can right-click on any tile and select Resize to alter the tile's dimensions—just like on the Windows 8 Start screen.

Alternatively, if you loathe Live Tiles and the Metro interface with the ferocity of a thousand suns, you can also right-click on every one of the defaults in the Start menu and select Uninstall to wipe them from your system. (Or simply Unpin from Start if you'd rather hide than eradicate them.) Repopulate them with desktop software of your choosing—you can right-click any app or program and select Pin to Start—and before you know it, it'll be kind-of-sort-of like the Windows 7 Start menu all over again.

MAKE MAIL YOUR OWN

Windows 10's overhauled Mail and Calendar apps rock compared to Windows 8's lackluster offerings. They're lightning fast, more full-featured, and infinitely more mouse-friendly than before.

Even better, the new Mail adds customization options that let you put a personal touch on the app. Not only can you change the image in the preview pane with the picture of your choice, but you can also configure how Mail behaves when you perform on of
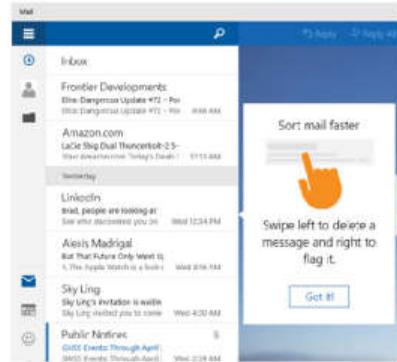
its new swipe gestures on a message.

To start tinkering, click the cog icon in the lower-left corner of the app, then select Options. Wah-lah! You'll find all the gesture options in the Quick Actions portion.

TURN OFF FILE EXPLORER'S QUICK ACCESS VIEW

When you open File Explorer in Windows 10, it defaults to a new Quick Access view that shows your most frequently accessed folders and recently viewed files. I love it, personally, but if you'd rather File Explorer defaulted to the "This PC" view found in Windows 8, here's how.

Open File Explorer, then select View > Options from the Ribbon. A Folder Options window will open. Click the "Open File Explorer" drop-down menu at top, then select the "This PC" option. Click OK and you're done!
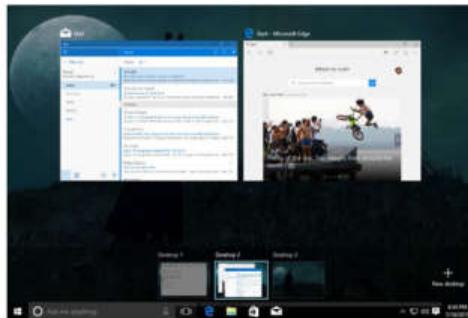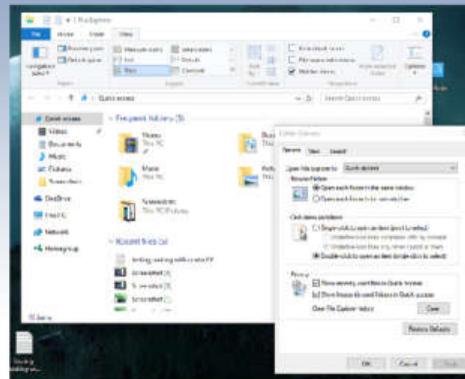
Move open windows between virtual desktops

Virtual desktops let you segregate your open apps into discrete areas—literally multiple, virtualized versions of your PC's desktops. Switching between open virtual desktops is easy enough using Task View (the button that looks like two panels, one over the other, in the taskbard) or Windows key + Tab, while Alt + Tab jumps you between open apps across all desktops. There's also a way to actually shift an open app from one virtual desktop to another if you'd like to shuffle things around.

First, head to the virtual desktop housing the app you'd like to move to another virtual desktop, then open the Task View interface. Just click-and-hold on the app you'd like to move, then drag it to the desired virtual desktop at the bottom of the screen. You can also drag it to the "+New Desktop" option in the lower-right corner to create a new virtual desktop for the app.

← Settings

⚙ ADVANCED OPTIONS

Choose how updates are installed

Notify to schedule restart ⌄

You'll be asked to schedule a restart to finish installing updates. Updates won't download over a metered connection (where charges may apply).

☐ Give me updates for other Microsoft products when I update Windows.

☐ Defer upgrades
  Learn more

View your update history

Choose how updates are delivered

Schedule your restarts

This is wonderful. If you've got pending updates that require you to reboot your PC, Windows 10 will allow you to schedule a specific time for it to do so. Finally!

Open the Settings option in the Start menu, then head to Updates and Recovery > Windows Update. If you have an update pending, you'll see the screen at left, which lets you schedule your reboot after you select the "Select a restart time" radio button. Even better, you can dive into the Advanced options and link and ask Windows to notify you to schedule a reboot whenever updates are ready to rock.

GET WINDOWS UPDATES FROM OTHER SOURCES

But the Windows Update upgrades don't end there. Windows 10 introduces a new option that lets you download updates using peer-to-peer technology, rather than Microsoft directly. It could help you get that hot security patch faster when everybody's hammering Microsoft's dedicated servers, or save you bandwidth in a computer-crowded house—just download the new patch once from Microsoft, then share it among the PCs under your care.

To tinker with the setting, head to Settings > Update & Recovery > Windows Update > Advanced Options > Choose how you download updates. By default, "Get updates from more than one place" is enabled and configured to grab updates from PCs on both your local network and the Internet at large.

⚙ CHOOSE HOW UPDATES ARE DELIVERED

Updates from more than one place

Download Windows updates and apps from other PCs in addition to Microsoft. This can help speed up app and update downloads.
Learn more

When this is turned on, your PC may also send parts of previously downloaded Windows updates and apps to PCs on your local network, or PCs on the Internet, depending on what's selected below.

🔵 On

Get updates from Microsoft, and get updates from and send updates to

○ PCs on my local network

SECRET, POWERFUL NEW COMMAND PROMPT TOOLS

Windows 10 packs a slew of nifty new command line features, including— hallelujah!—the ability to copy and paste inside the command prompt with Crtl + C and Crtl + V.

To activate the goodies, open the command prompt. Right-click its title bar, then select Properties. You can find and enable the new features under the "Edit Options" section of the Options tab.
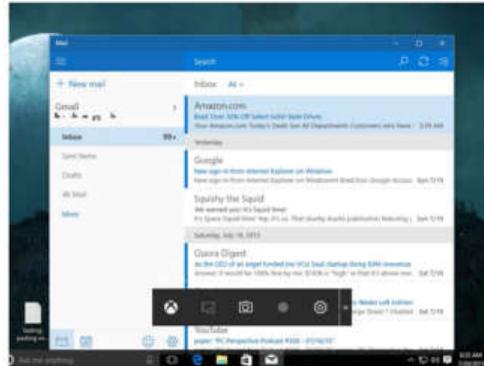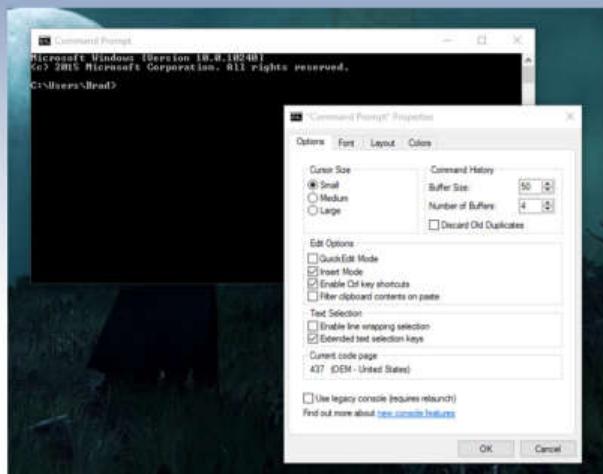
Record a video of an app

Windows 10's new Game DVR function is supposed to be used for recording video evidence of your most glorious gaming moments, but it'll actually let you create videos of any open app or desktop software (though not OS-level areas like File Explorer or the desktop).

To summon it, simply press Windows key + G. A prompt will ask you if you want to open the Game bar. Lie your butt off and click the "Yes, this is a game box" and various options will appear in a floating bar. Simply click the circular Record button to capture a video. You can find your saved videos in the Game DVR section of the Xbox app, or inside your user folder under Video > Captures.

Fresh keyboard shortcuts!

Windows 10 packs a handful of fresh keyboard shortcuts, all tied to newfound abilities inside the revamped operating system. There are many more than we can list here, so head over to PCWorld's guide to Windows 10's keyboard shortcuts (go.pcworld.com/ w10keycuts) to learn all about them.

GODMODE

The legendary GodMode, a hidden staple for Windows power users, makes its return in Windows 10 (go.pcworld.com/w10godmode). As before, activating it unveils a power user menu that brings together all of your system's far-flung settings and configuration options into a single location. Just create a new folder and rename it to following:

GodMode.{ED7BA470-8E54-465E-825C-99712043E01C}

Don't forget the period after "GodMode", and you can rename the "GodMode" portion whatever you'd like if you want another name for the folder.
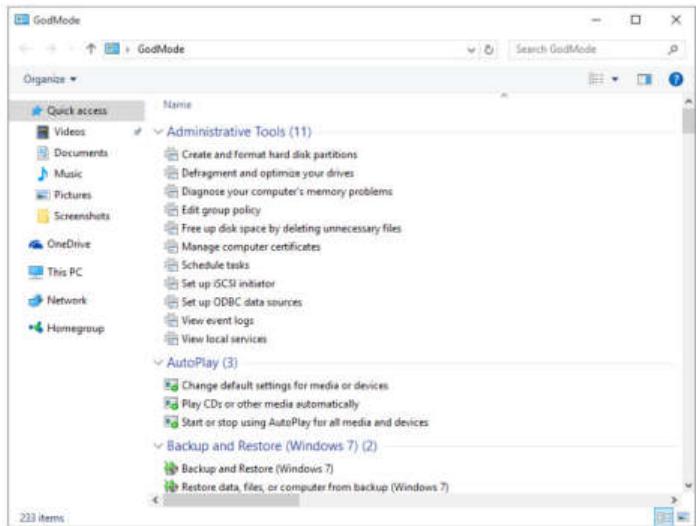
SOLITAIRE RETURNS!

After being banished to the Windows Store in Windows 8, Solitaire is back in Windows 10, baby. But it can be tricky to find.

Solitaire's not in the Start menu, and its old Start > Programs> Accessories > Games stomping grounds aren't found in Windows 10. Looking for Solitaire in the All Apps section of the Start menu is also a fruitless endeavor—but that's because the game's officially called "Microsoft Solitaire Collection Preview." You can find that in All Apps, or just search for Solitaire. It'll pop right up.

Enjoy!

SOS!

Did you break something in Windows 10 or one of your Microsoft apps? Don't sweat it— help is just a few clicks away.

Just look for the new Contact Support app inside the All Apps menu. It can point you towards the appropriate community forums to find help for the issue, or even connect you with a Microsoft support representative via online chat or phone if you stumble into a particularly bad problem.
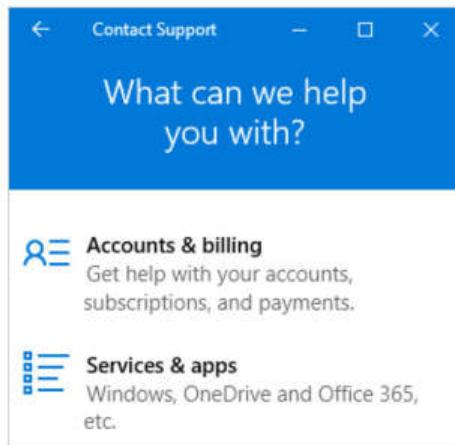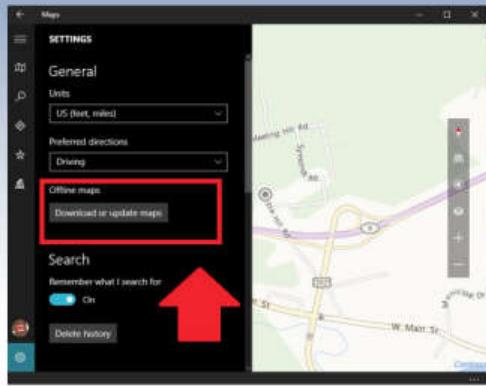
Offline Maps

Speaking of apps, the revamped universal Maps app, like any maps tool worth using (and unlike the Windows 8 Maps app), packs an offline maps feature. Click the Settings (gear) icon in Maps, then select Download or update maps under the "Offline maps" header.

You'll be bounced to the Settings app, where you'll be able to select which continent, then country whose offline map you'd like to download. (If you're downloading a U.S. map, you'll also have to select which state you need.) Helpfully, Windows tells you how large the download will be before you start scraping the maps.

CHAMELEON

The customization doesn't end there. Windows 10 offers you more granular control over the color of your taskbar, Start menu, and search field.

Open the Start menu and head to Settings > Personalization > Colors to start tweaking things. The "Automatically pick a color from my background" option does what it claims, then applies that color to the Cortana/search field and underneath the icons of open apps. "Show color on taskbar and Start menu" also does just that, while disabling "Make Start menu transparent"—which is enabled by default—removes the subtle see-through effect in favor of a full-blown opaque background for both the Start menu and the taskbar.
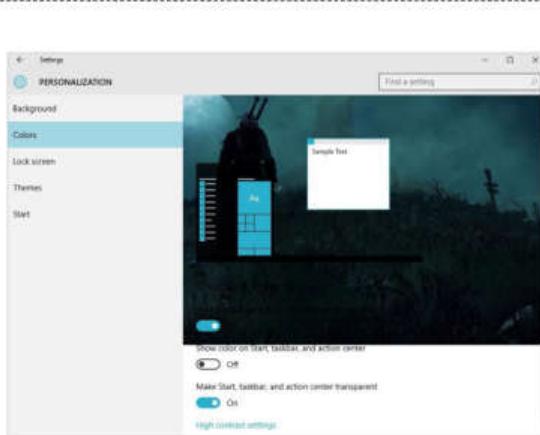
ENABLE TABLET MODE

Windows 10's Continuum, which dynamically switches from the traditional desktop to a more Metro-like interface when you're using a touchscreen, is supposed to kick into action when you connect or disconnect a keyboard from your Windows hybrid or tablet. But what if you're using a standard PC and just plain love full-screen apps and the Live-Tile-strewn Start screen, rather than the Start menu?

Easy! Activate Tablet Mode. Open up Windows 10's new Action Center—the small icon that looks like a comic-book word bubble in your system tray—and click the Tablet Mode button. Everything will be removed from your desktop, save for spaced-out icons for the Start button, Cortana, and Task View. (Want your open and pinned apps to stay on the taskbar? The option's found in Tablet Mode settings, which we cover later.) Now press the Start button to bask in the full-screen apps and Start screen, since that's obviously your thing.

Tinker with Tablet Mode

But what if you don't want to fuss with all that manual Tablet Mode labor? While Windows 10 should intelligently switch between the two when you're using a hybrid, you can also tweak how the operating system handles Continuum.

Simply search for "Tablet Mode" and select the "Tablet Mode Settings" option that appears. Here, you'll be able to tell Windows whether you want to even use Tablet Mode on this device, and specify how you want to handle Tablet Mode prompts if so. You can also tell Windows to keep your open and pinned apps on the taskbar when in Tablet Mode if you so desire, as well as to boot into tablet mode at startup.
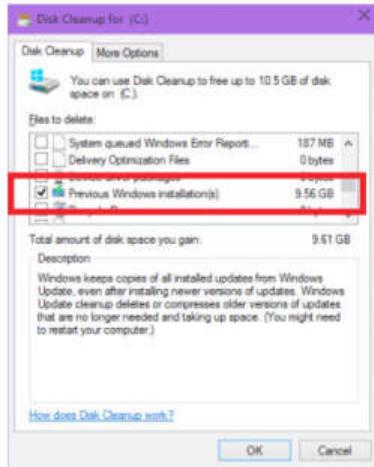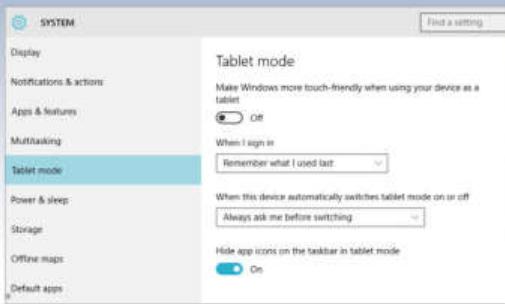
GET RID OF THE OLD STUFF

When you upgrade to Windows 10 over an existing Windows 7 or 8 installation, it keeps a copy of your old operating system around in a folder dubbed Windows.old just case you need to revert back for any reason. If you know you're never going back you can delete that folder to reclaim the lost gigabytes—but it's not as simple as right-clicking on it and selecting Delete.

Search for "Free up disk space by deleting unnecessary files". Click the shortcut, select your primary hard drive (if you have multiple installed), and in the window that appears, click "Clean up system files." After Windows thinks for a second, check the "Previous Windows installations" box in the list, then click OK and confirm you want to delete the files.

MANAGE YOUR NOTIFICATIONS

System-wide notifications were a highlight feature for Windows Store apps in Windows 8, and Windows 10's new Action Center lets you actually manage them, making notifications useful rather than one-off shouts into the wind.

You might not want every Windows Store app you install barking at you all the time, however, or maybe you don't want to see any notifications while you're in presentation mode. To tinker with you your notification settings, head to Start menu > Settings > Systems > Notifications and actions. Individual Windows Store apps tend to have more granular notification options in the Settings menus inside the apps themselves.
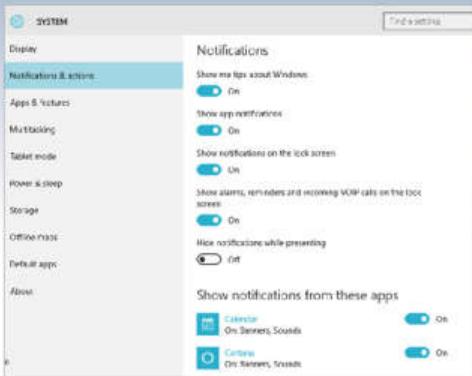
Edge's reading enhancements

Windows 10's new Edge browser drags Microsoft's web efforts into the modern era, with a blazing fast engine and nifty forward-thinking tricks like intelligent, automatic Cortana integration for supplementing the info you're looking at. But to me, the most refreshing aspects of Edge are its reader-first extras, which carry over from Windows 8's Metro IE app: Reading View and Reading List.

Reading View (the small book icon, next to the bookmark star in the browser bar) strips away ads, sidebar images, and other clutter to present a clean, straightforward reading experience. Edge also supports sharing to the Reading List app, which functions like Pocket or Instapaper, essentially letting you a story for later reading. To save a juicy article, simply click the bookmark star and opt to save the article to your Reading List rather than as a bookmark.

I was one of the **1** in **5** Children in America who STRUGGLE WITH HUNGER join me and help put an End to childhood hunger.

Viola Davis

HUNGER IS
ALL OF US

HELP UNDO CHILDHOOD HUNGER. GO TO HUNGERIS.ORG

20 MUST-KNOW KEYBOARD SHORTCUTS FOR WINDOWS 10

Windows 10 has a bunch of new features that bring new keyboard shortcuts along with them. Here's a list of the best keyboard shortcuts to know to make your time with Windows 10 more efficient. **By Ian Paul**

With Windows 10, Microsoft has added a ton of new keyboard shortcuts to give you easier access to the new Action Center, Cortana, Task View, and virtual desktops. So much so, in fact, that Microsoft recently released a handy-dandy Word document with Windows 10's Windows key shortcuts to aid in your study.

If you're new to keyboard shortcuts, however, one glance at that list can be overwhelming—and there are plenty of keyboard shortcuts that don't involve the Windows key whatsoever. To help you streamline it a bit, here's a list of 20 must-know shortcuts for Windows 10.

This isn't just a list for Windows 10, however. Many of these shortcuts work with older versions of Windows, and you'll find a few standard browser shortcuts as well. If you're on Windows 7 or 8.1 but new to shortcuts this list will also help you take control of your Windows machine and make you more efficient by lessening your dependence on the mouse.

WINDOWS 10's
NEWEST FEATURES

OPEN THE ACTION CENTER

⊞ + A

OPEN TASK VIEW

⊞ + TAB

OPEN THE SETTINGS APP

⊞ + I

CREATE A NEW VIRTUAL DESKTOP

⊞ + CTRL + D

LAUNCH CORTANA IN LISTENING MODE

⊞ + C

CLOSE THE CURRENT DESKTOP

⊞ + CTRL + F4

LAUNCH CORTANA

⊞ + S

SWITCH BETWEEN VIRTUAL DESKTOPS

⊞ + CTRL + → OR ←

STANDARD
WINDOWS SHORTCUTS

**OPEN/CLOSE THE
START MENU**

[⊞ Windows]

WINDOWS 7 AND UP

**OPEN/CLOSE THE START BUTTON'S
RIGHT-CLICK CONTEXT MENU**

[⊞ Windows] + [X]

WINDOWS 8.1 AND 10

**LAUNCH
FILE EXPLORER**

[⊞ Windows] + [E]

WINDOWS 7 AND UP

**SNAP CURRENT WINDOW TO
RIGHT OR LEFT OF SCREEN**

[⊞ Windows] + [→ OR ←]

WINDOWS 7 AND UP

**LOCK THE
DESKTOP**

[⊞ Windows] + [L]

WINDOWS 7 AND UP

**TAKE A SCREENSHOT OF CURRENT
WINDOW & COPY IT TO YOUR CLIPBOARD**

[ALT] + [PRT SCN]

WINDOWS 7 AND UP

**TAKE A SCREENSHOT OF ENTIRE DISPLAY AND
SAVE TO *COMPUTER > PICTURES > SCREENSHOTS***

[⊞ Windows] + [PRT SCN]

WINDOWS 8.1 AND 10

BROWSER
SHORTCUTS

Work in Edge and most other browsers

**OPEN
NEW TAB**

CTRL + **T**

**HIGHLIGHT
CURRENT URL**

CTRL + **L**

**BOOKMARK
PAGE**

CTRL + **D**

**CYCLE THROUGH
OPEN TABS**

CTRL + **TAB**
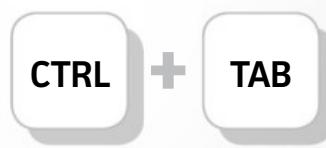
**ADD ".COM" TO THE END OF A WEB ADDRESS
(E.G. TYPE 'GOOGLE' THEN CTRL + ENTER TO GET GOOGLE.COM)**

CTRL + **ENTER**

Ready.gov/business

We've MOVED
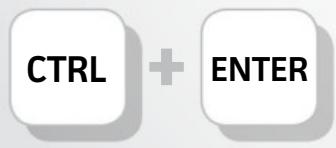
WHERE WILL DISASTER LEAVE YOUR BUSINESS

Up to 40% of businesses never recover after experiencing a major disaster.
Do you have a plan to keep your business running if disaster strikes?
For a free online tool that helps you develop an emergency plan,
visit Ready.gov/business.

HERE'S HOW

CONTENTS

4 ways to turn off annoying notifications on your Android phone or iPhone

Weed out the random calls, messages, and alerts, and focus only on the ones that really matter to you.

BY BEN PATTERSON
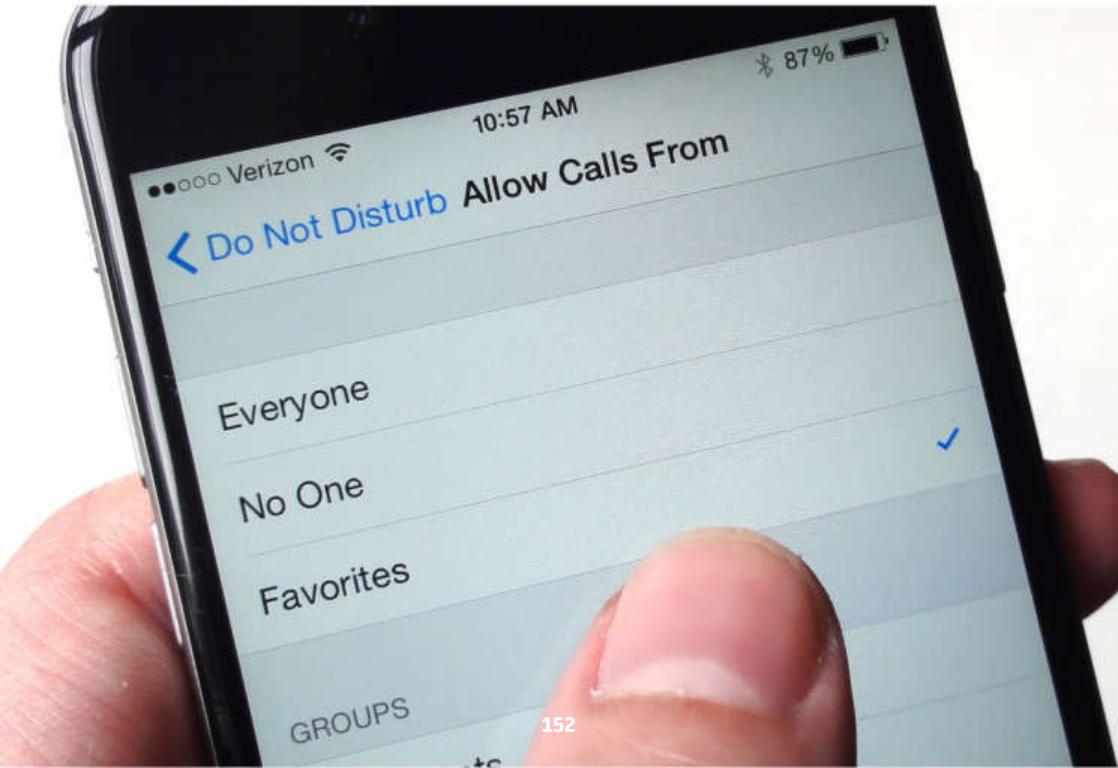
SO THERE YOU are, doing your best to connect with a friend over a cup of coffee, and you can't help but notice the pulsing alert on your phone's touchscreen. What if it's your babysitter trying to reach you, or a nasty email from your boss?

You surreptitiously unlock your phone to see what the fuss is about—and just like that, you become one of those people who can't keep their hands off their handsets, even when there's a flesh-and-blood person in front of them. (Oh, and that message on the screen? It was a promo for a half-off sale. Great.)

The good news is that your Android phone or iPhone boasts a series of tools that can help you concentrate on the people who matter, rather than being distracted by random calls, messages, and alerts.

Read on for four ways to keep your eyes and hands off your phone, starting with…
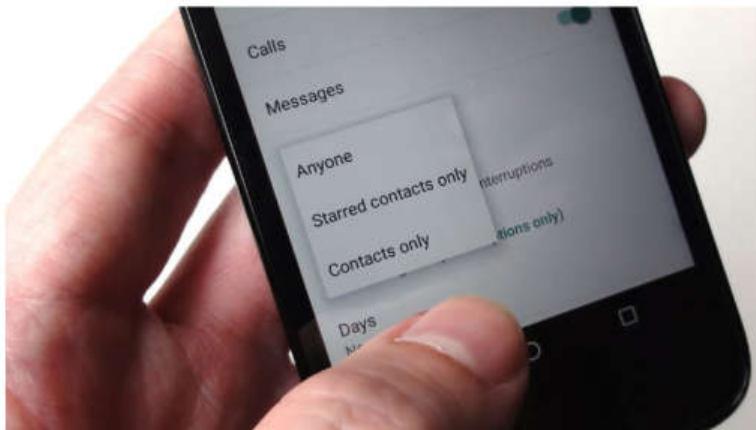
You can set "Do Not Disturb" and "Priority" mode (pictured) to screen your calls and text messages, allowing only the most important ones through.

Let the Do Not Disturb (iOS) and Priority (Android) modes screen your calls

Sure, activating Do Not Disturb mode for your iPhone and iPad (tap Settings ➔ Do Not Disturb, or tap the Do Not Disturb button from the swipe-up Command Center pane) or Priority mode on Android (click the volume button, then tap Priority) is a great way to keep your

phone from buzzing during lunch, but you may still find yourself tempted to check your messages. After all, what if your spouse is trying to reach you—or your irate supervisor, for that matter?

Here's a trick that'll help keep your mind on your Caesar salad: just set Do Not Disturb or Priority mode to screen your calls and text messages, allowing only the most important ones through. That way, you'll be confident that your silent Android phone or iPhone isn't actually ringing off the hook with mission-critical calls, and more likely to pay attention during your lunchtime chat.

For Android:

Tap Settings ➜ Sound & Notification ➜ Interruptions, then make sure the Calls and Messages switches are toggled on. Next, tap Calls/Messages and choose the Starred Contacts Only option, then go through the Contacts app and star only those contacts who really, truly matter to you.

To enable Priority mode, click the volume button to make the volume slider appear, then tap Priority.

Finally, sit back and give your full, undivided attention to a (grateful) friend.

For iOS:

Tap Settings ➜ Do Not Disturb ➜ Allow Calls From, then pick the Favorites setting. Once you do, calls and text messages from those on your iOS Favorites list will ring through even with Do Not Disturb mode switched on.

You can also pick a specific contact group for the Allow Calls From setting, but you can only set up contact groups using the Mac version of the Contacts app. Open the Contacts application on your Mac desktop, then click File ➜ New Group to get started. As long as you're syncing your contacts using iCloud, your desktop groups in Contacts will sync up with the Contacts iOS app.

You can also enable the Repeated Calls setting, which will allow urgent callers to break through Do Not Disturb mode if they call twice within three minutes.

Mail's VIP alerts give you separate notifications for your most important email contacts.

Enable VIP alerts for email messages (iOS only)

There's little chance you'll get through an important meeting without glancing at your iPhone if your screen is constantly flashing with alerts for new email messages. Luckily, the iOS Mail app has a feature that can ease your email notification overload.

Mail's VIP alerts give you separate notifications for your most important email contacts, perfect for leaving you alone unless a message from a close friend or someone in upper management lands in your inbox.

Open the Mail app, back up to the main Mailboxes screen, tap the VIP mailbox, then tap Add VIP to add a contact to your VIP list. Once you've added some names to the list, tap VIP Alerts to manage your VIP notifications. You could, for example, give messages from VIPs a special ringtone or a custom vibration when they arrive in your inbox, or allow VIP alerts—and only VIP alerts—to light up your lock screen.

Turn on alerts for Gmail's Priority Inbox—and off for all your other inboxes (Android & iOS)

While iOS's Mail app will let you pick and choose your VIPs, Gmail has its own secret formula for determining which messages are most important to you.
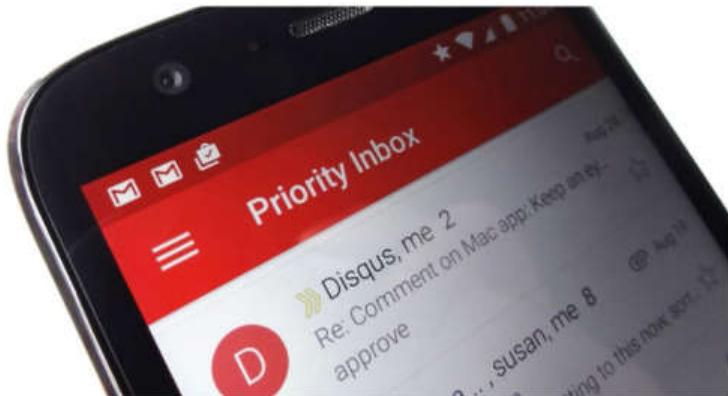
Gmail's Priority Inbox sifts through your incoming messages and finds the email that you're most likely to want to answer.

Using your prior emailing habits as a guide, Gmail's Priority Inbox sifts through your incoming messages, finds the email that you're most likely to answer, and puts them into an Important And Unread folder. Everything else (such as random email promos, newsletters, and other lower-priority messages) goes into the aptly named Everything Else section of your inbox.

Once that's done, you can set Gmail to alert you only when new messages land in your Priority Inbox—and hopefully, you'll feel better about leaving your silenced phone alone.

For Android:

First, you'll need to enable Gmail's Priority Inbox feature. Open Gmail, tap the menu button in the top left corner of the screen, tap Settings, pick a Gmail account, then tap Inbox Type ➜ Priority Inbox.

Tap Manage Labels, then make sure that Priority Inbox is the only Gmail label with notifications turned on. (If you don't see a Sound On, Notify Once or similar tag next to a label, then notifications are off for that label.)

For iOS:

If you're using Gmail for iOS, you'll need to enable Priority Inbox from the desktop version of Gmail. Open Gmail in a desktop browser, click the Settings button, select Settings, click the Inbox tab, select Priority Inbox from the Inbox Type drop-down menu, then click Save Changes.

Go to the Gmail For iOS app, tap the menu button in the top left corner of the screen, tap the Settings button, choose the Important Only option under the Notifications heading, then tap Save.

Turn off unneeded lock-screen notifications (Android & iOS)
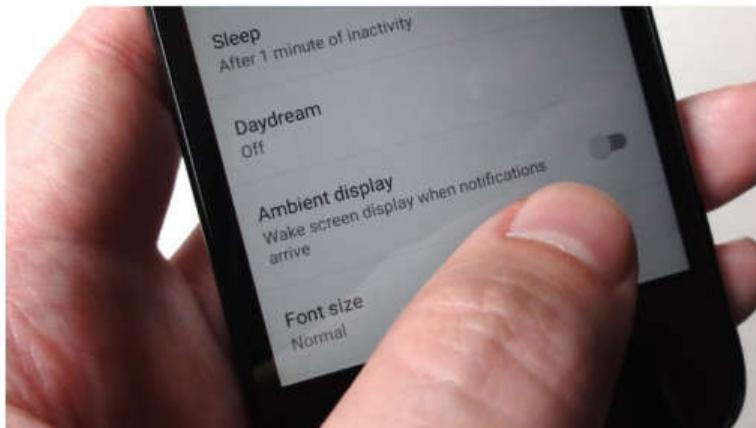
It's easy to pare your lock-screen notifications down to an absolute minimum—or turn the option off completely.

So, you're in a meeting, your phone is sitting dutifully—and silently—on the table in front of you, and you're giving your colleagues your full attention. But then it happens: Your phone's lock screen lights up, and your eyes can't help but flick down to the display…which is nothing more than a random Facebook update.

Luckily, it's easy to pare your lock-screen notifications down to an absolute minimum—or turn them off completely, even when you don't have Do Not Disturb or Priority mode switched on.

For Android:

To keep your phone's lock screen from lighting up when notifications come in, tap Settings ➜ Display, then toggle off the Ambient Display setting.

You can also completely turn off notifications for a specific app by tapping Settings ➜ Sound & Notification ➜ App Notifications, then tap an app and enable the Block setting. (Nope, you can't only disable lock-screen alerts for a given app; it's all or nothing.)

While you're at it, you might also want to turn off your handset's pulsing notification light—you know, the one that's saying "Look at me, look at me!" all the time. Go back to Settings ➜ Sound & Notification, then toggle on the Pulse Notification Light setting.

For iOS:

To completely turn off an app's notifications, tap Settings ➜ Notifications, tap an app, then toggle off the Allow Notifications switch.

If you only want to disable an app's lock-screen notifications, leave the Allow Notifications switch on but turn off the Show On Lock Screen setting. ⏻

Excel logical formulas: 5 simple IF statements to get started

BY JD SARTAIN

EXCEL FUNCTIONS, OR formulas, lie at the heart of the application's deep well of capabilities. Today we'll tackle IF statements, a string of commands that determine whether a condition is met or not. Just like a yes-no question, if the specified condition is true, Excel returns one user-determined value and, if false, it returns another.

The IF statement is also known as a logical formula: IF, then, else. **If** something is true, **then** do this, **else**/otherwise do that. For example, **if** it's raining, **then** close the windows, **else**/otherwise leave the windows open.

The syntax (or sentence structure; that is, the way the commands are organized in the formula) of an Excel IF statement is: =IF(logic_test, value_if true, value_if_false). IF statements are used in all programming languages and, although the syntax may vary slightly, the function provides the same results.

Remember: Learning Excel functions/formulas and how they work are the first steps toward using Visual Basic, Microsoft's event-driven programming language. Here are five easy IF statements to get you started.

Past-due notices

In this spreadsheet, the customer's payment due date is listed in column A, the payment status is shown in column B, and the customer's company name is in column C. The company accountant enters the date that each payment arrives, which generates this Excel spreadsheet. The bookkeeper enters a formula in column B that calculates which customers are more than

30 days past due, then sends late notices accordingly.

A. Enter the formula: **=TODAY()** in cell A1, which displays as the current date.

B. Enter the formula: **=IF(A4-TODAY()>30, "Past Due", "OK")** in cell B4.

In English, this formula means: **If** the date in cell A4 minus today's date is greater than 30 days, **then** enter the words *Past Due* in cell B4,

Use an IF statement to flag past-due accounts so you can send notices to those customers.

160

else/otherwise enter the word *OK*. Copy this formula from B4 to B5 through B13.

Pass/Fail lifeguard test

The Oregon Lifeguard Certification is a Pass/ Fail test that requires participants to meet a minimum number of qualifications to pass. Scores of less than 70 percent fail, and those scores greater than that, pass. Column A lists the participants'

	A	B	C	D	E	F	G
1	Oregon State Lifeguard Certification						
2							
3	Participants	Grade	Pass/Fail				
4	Cantrell, Larry	74	PASS				
5	Cooper, Michael	70	PASS				
6	DeLuka, Carla	54	FAIL				
7	Leighton, Daniel	84	PASS				
8	McLachlan, Andy	78	PASS				
9	Pendergrass, Glynn	62	FAIL				
10	Schultz, Amy	56	FAIL				
11	Toney, Brenda	68	FAIL				
12	Weaver, Gail	92	PASS				
13	Willette, Debbie	88	PASS				
14							

Cell M20 formula: =IF(B4<70,"FAIL","PASS") **Ⓐ**

names; column B shows their scores; and column C displays whether they passed or failed the course. The information in column C is attained by using an IF statement.

Once the formulas are entered, you can continue to reuse this spreadsheet forever. Just change the names at the beginning of each quarter, enter the new grades at the end of each quarter, and Excel calculates the results.

A. Enter this formula in cell C4: **=IF(B4<70,"FAIL","PASS")**. This means if the score in B4 is less than 70, **then** enter the word *FAIL* in cell B4, **else**/otherwise enter the word *PASS*. Copy this formula from C4 to C5 through C13.

Sales & bonus commissions

Wilcox Industries pays its sales staff a 10 percent commission for all sales greater than $10,000. Sales below this amount do not receive a bonus. The names of the sales staff are listed in column A. Enter each

Use an IF statement to convert numeric scores to a pass-fail status.

person's total monthly sales in column B. Column C multiplies the total sales by 10 percent, and column D displays the commission amount or the words *No Bonus*. Now you can add the eligible commissions in column D and find out how much money was paid out in bonuses for the month of August.

A. Enter this formula in cell C4: **=SUM(B4*10%)**, then copy from C4 to C5 through C13. This formula calculates 10 percent of each person's sales.

B. Enter this formula in cell D4: **=IF(B4>10000, C4, "No bonus")**, then copy from D4 to D5 through D13. This formula copies the percentage from column C for sales greater than $10,000 or the

Use an IF statement to calculate sales bonus commissions.

162

words *No Bonus* for sales less than $10,000 into column D.

   C. Enter this formula in cell D15: **=SUM(D4:D13)**. This formula sums the total bonus dollars for the current month.

Convert scores to grades with nested IF statements

This example uses a "nested" IF statement to convert the numerical Math scores to letter grades. The syntax for a nested IF statement is this: IF data is true, then do this; IF data is true, then do this; IF data is true, then do this; IF data is true, then do this; else/otherwise do that. You can nest up to seven IF functions.

   The student's names are listed in column A; numerical scores in Column B; and the letter grades in column C, which are calculated by a nested IF statement.

A. Enter this formula in cell C4: **=IF(B4>89,"A",IF(B4>79,"B",IF(B4>69,"C",IF(B4>59,"D","F"))))**, then copy from C4 to C5 through C13.

Note: Every open, left parenthesis in a formula must have a matching closed, right parenthesis. If your formula returns an error, count your parentheses.

Determine sliding scale sales commissions with nested IF statements

This last example uses another nested IF statement to calculate multiple commission percentages based on a sliding scale, then totals the commissions for the month. The syntax for a nested IF statement is this: IF data is true, then do this; IF data is true, then do this; IF data is true,

Use a nested IF statement to calculate different commissions based on different percentages.

then do this; else/otherwise do that. The names of the sales staff are listed in column A; each person's total monthly sales are in column B; and the commissions are in column C, which are calculated by a nested IF statement, then totaled at the bottom of that column (in cell C15).

    A. Enter this formula in cell C4: **=IF(B4<5000,B4*7%,IF(B4<8000,B4*10%,IF(B4<10000,B4*12.5%,B4*15%)))**, then copy from C4 to C5 through C13.

    B. Enter this formula in cell C15: **=SUM(C4:C13)**. This formula sums the total commission dollars for the current month. ⏻
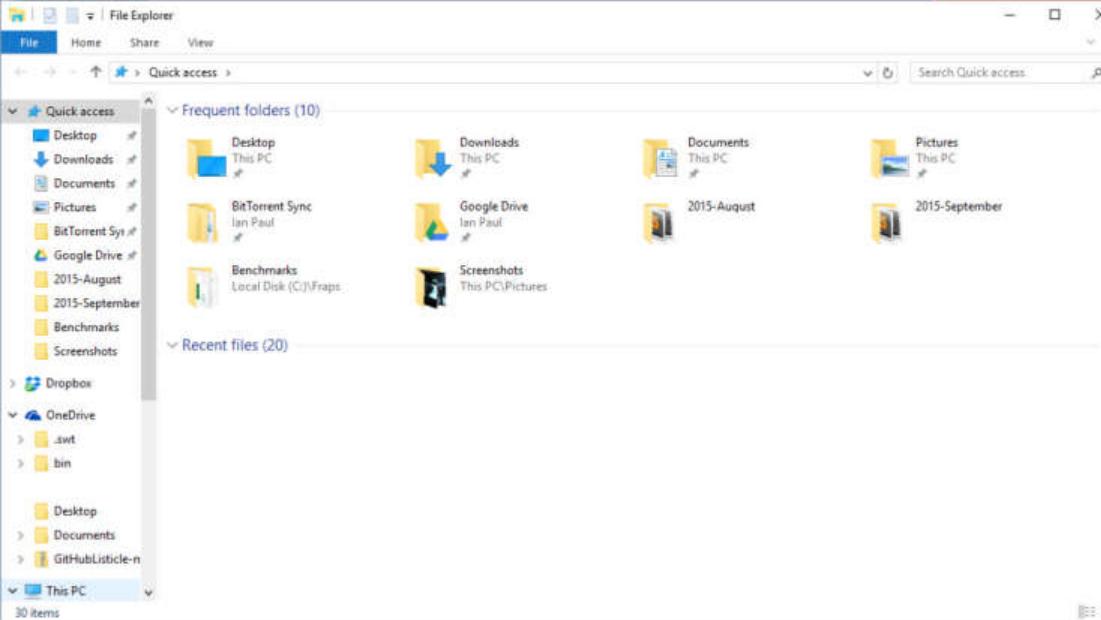
How to customize File Explorer's details view in Windows

You spend a lot of time diving into the file system on a PC. Getting File Explorer organized just the way you like it is quick, easy, and worth it.

WE'VE TALKED ABOUT File Explorer (go.pcworld.com/w7file-explorer; Windows Explorer in Windows 7) several times before, and if you ask me it's one of the most important parts of Windows to customize. Unlike a smartphone or tablet, you spend a lot of time diving into your PC's file system and it's worth it to get things organized just how you like it.

One good way to do that is to customize a folder's column order—name,

size, type, date modified, and so on—under the details view. It's really easy to organize columns in the order you'd like instead of just using the defaults. In fact, you can even apply a particular column order that you create to most other folders on your system.

I'll be showing how it's done in Windows 10, but it works similarly in Windows 7 and 8.

Sorting downloads

Let's say you wanted to have the date show up first in the downloads folder. Just click on Date at the top of the column, and then drag it to the left. If you wanted to put the date column last, you'd do the reverse.

If you then wanted to sort everything by date, single-click on the Date column. Now all the files in the downloads folder will be sorted by date with the oldest items at the top. To reverse that order just click Date again.

This trick works for all columns.
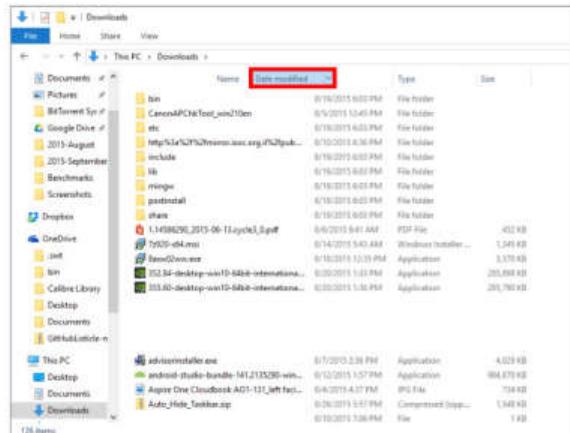
Moving columns is as easy as a drag-and-drop.

Making a template

Now, let's say you wanted to use a particular column setup from your downloads folder across all generic folders on your PC.

In Windows 10, click on This PC in the left-hand navigation column of File Explorer, then right-click on Downloads in the main window and select Properties from the context menu.

Click on the Customize tab and look under the first section, which reads Optimize This Folder For.

The drop-down menu you see there consists of five options that are the standard layout templates for File Explorer. By default in Windows 10, the downloads folder uses the pictures template. Let's change

that to General Items so that our downloads setup can affect most of our folders while leaving the standard Windows documents, music, and video folders untouched. You should also click the checkbox next to Also Apply This Template To All Subfolders.

If you've already customized your downloads folder, then changing to General Items will, unfortunately, return all column headings to the standard General Items template. Sort them again the way you like. For example, someone might prefer to see the filenames first, followed by file size, then file type, and finally the date.

Once it's sorted, go to the File Explorer menu at the top and select View ➜ Options ➜ Change Folder And Search Options. Under the View tab click Apply To Folders. A pop-up window will appear asking you to confirm the change to all folders of the same type (General Items in this case). Click Yes, and all your generic folders should now default to your predefined structure.

You can even switch other folders to your template by simply changing the template for that folder under Properties ➜ Customize.

To revert back to the standard layout for all folders, go back to View ➜ Options ➜ Change Folder And Search Options and under the View tab click Reset Folders. 🔴

Windows offers five standard templates for organizing File Explorer.

This setting allows you to change similar folders on the same system with one click.
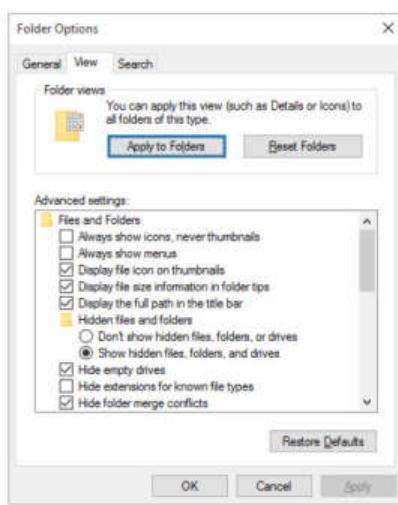
How to turn off Windows 10's keylogger

Microsoft can track your keystrokes, your speech, and more. Here are the settings to turn it all off.

J Confusion worries that, despite assumptions that it would be removed, the final version of Windows 10 still has a keylogger.

Last fall, I discussed the keylogger that Microsoft openly put into the Windows 10 Technical Preview. The company admitted that "we may collect voice information" and "typed characters." At the time I defended Microsoft, pointing out that the Preview was "intended for testing, not day-to-day use," and that Microsoft recommended against
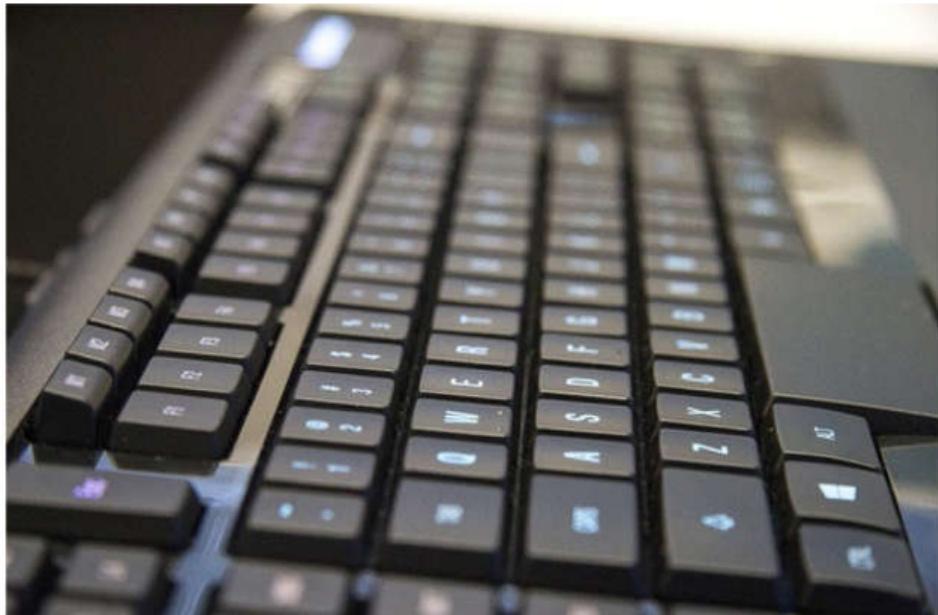
installing the Preview on a computer with sensitive files. I said that "I seriously doubt that the worst spyware features will remain in the finished product."

I was wrong.

Microsoft pretty much admits it has a keylogger in its Windows 10 speech, inking, typing, and privacy FAQ: "When you interact with your Windows device by speaking, writing (handwriting), or typing, Microsoft collects speech, inking, and typing information—including information about your Calendar and People (also known as contacts)…"

If that feels creepy to you, welcome to the human race.

Speaking of online Microsoft documents, you may want to browse the company's overall Privacy Statement. To Microsoft's credit, it's in plain English rather than legalese. On the other hand, it's about 17,000 words (as someone who's paid by the word, I'm frankly jealous), so it will take time to find out if there's anything else that's truly awful inside.

The good news is that you can turn off the keylogging. Click Settings (it's on the Start Menu's left pane) to open the Settings program. You'll find Privacy…ummm… hold on a sec…OH! There it is!—on the very last row.

Once in Privacy, go to the General section and turn off "Send Microsoft info about how I write to help us improve typing and writing in the future." While you're there, examine the other options and consider if there's anything else here that you may want to change.
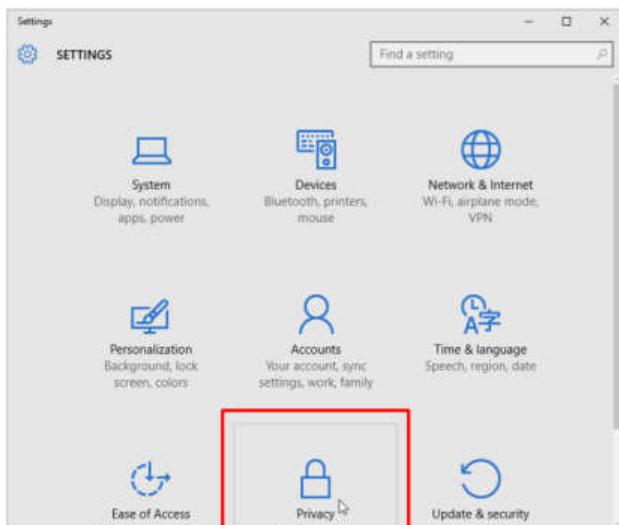
Now go to the Speech, Inking, & Typing section and click Stop Getting To Know Me. (I really wanted to end that sentence with an exclamation point.)

You may also want to explore other options in Privacy. For instance, you can control which apps get access to your camera, microphone, contacts, and calendar. I wish I had that capability in Android. ⏻

Have a tech question? Ask PCWorld *Contributing Editor Lincoln Spector. Send your query to* answer@pcworld.com
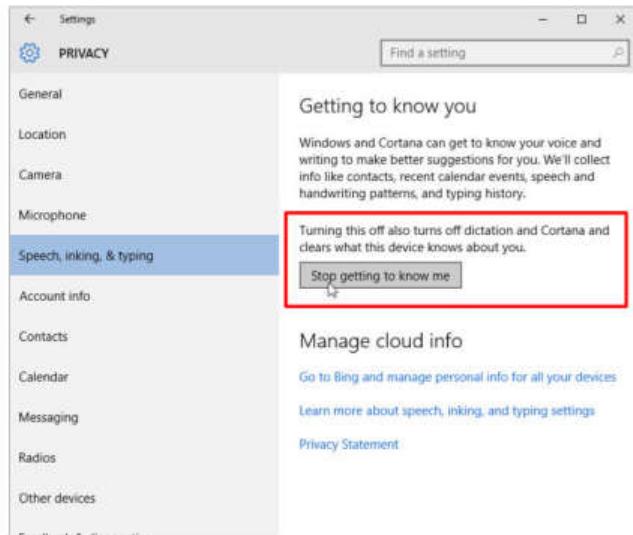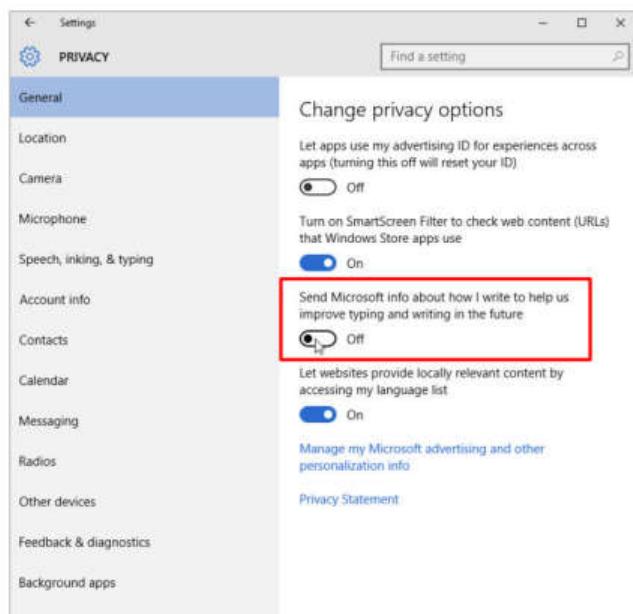
Tech Spotlight

A video showcase of the latest trends

Seriously, a connected electric razor? Seriously?

>> Okay, Internet of Things, you can stop now. Check out this $300 electric razor that can track how often and how long you shave, and estimate how sensitive your skin is based on how much you use different components. You had no idea you needed this, did you? Neither did we.